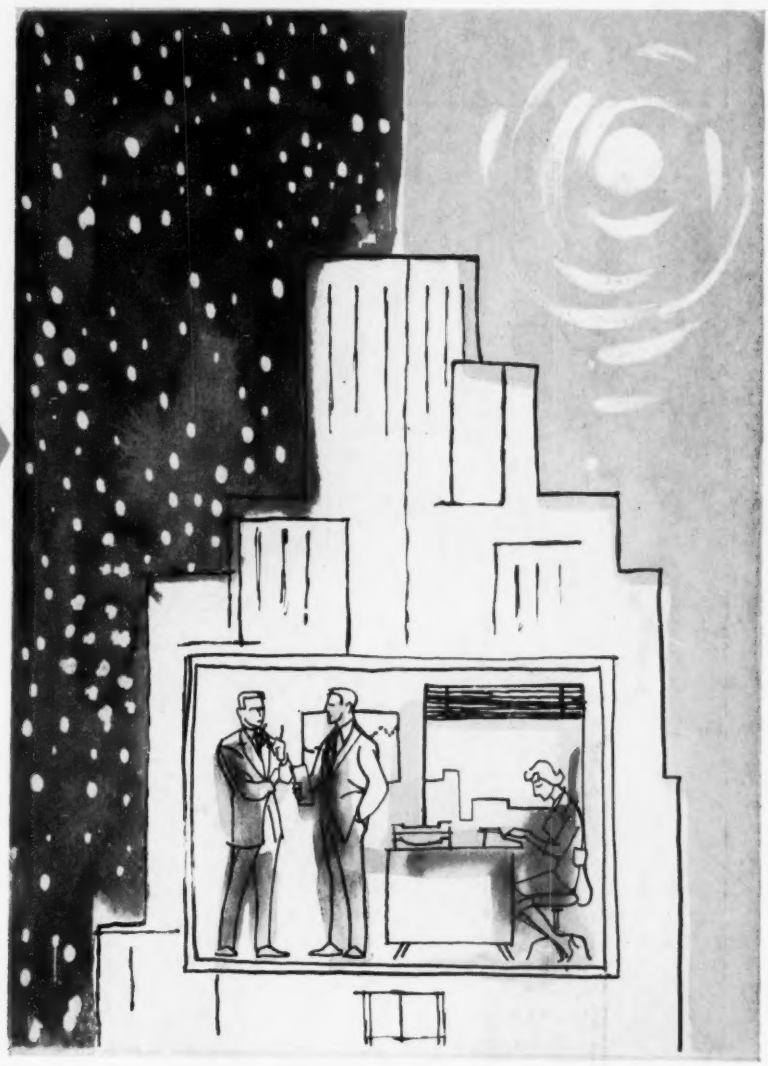
75th Year of service to the advancing power field

Power

JUNE 1957
ONE DOLLAR
A McGRAW-HILL PUBLICATION

Heat pumps bid for the cold climes

...see p 73



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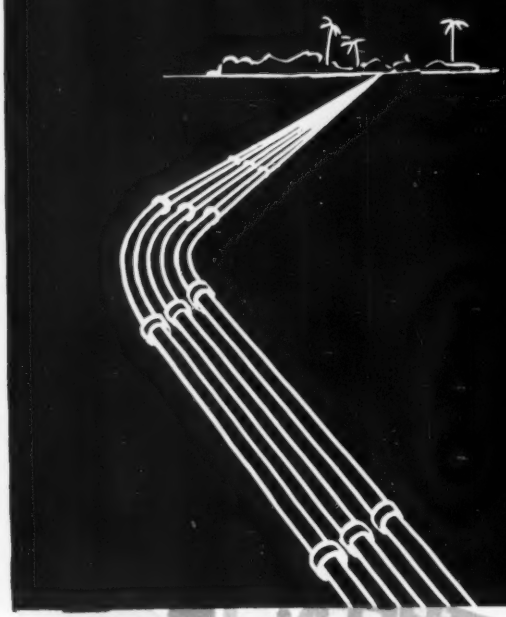
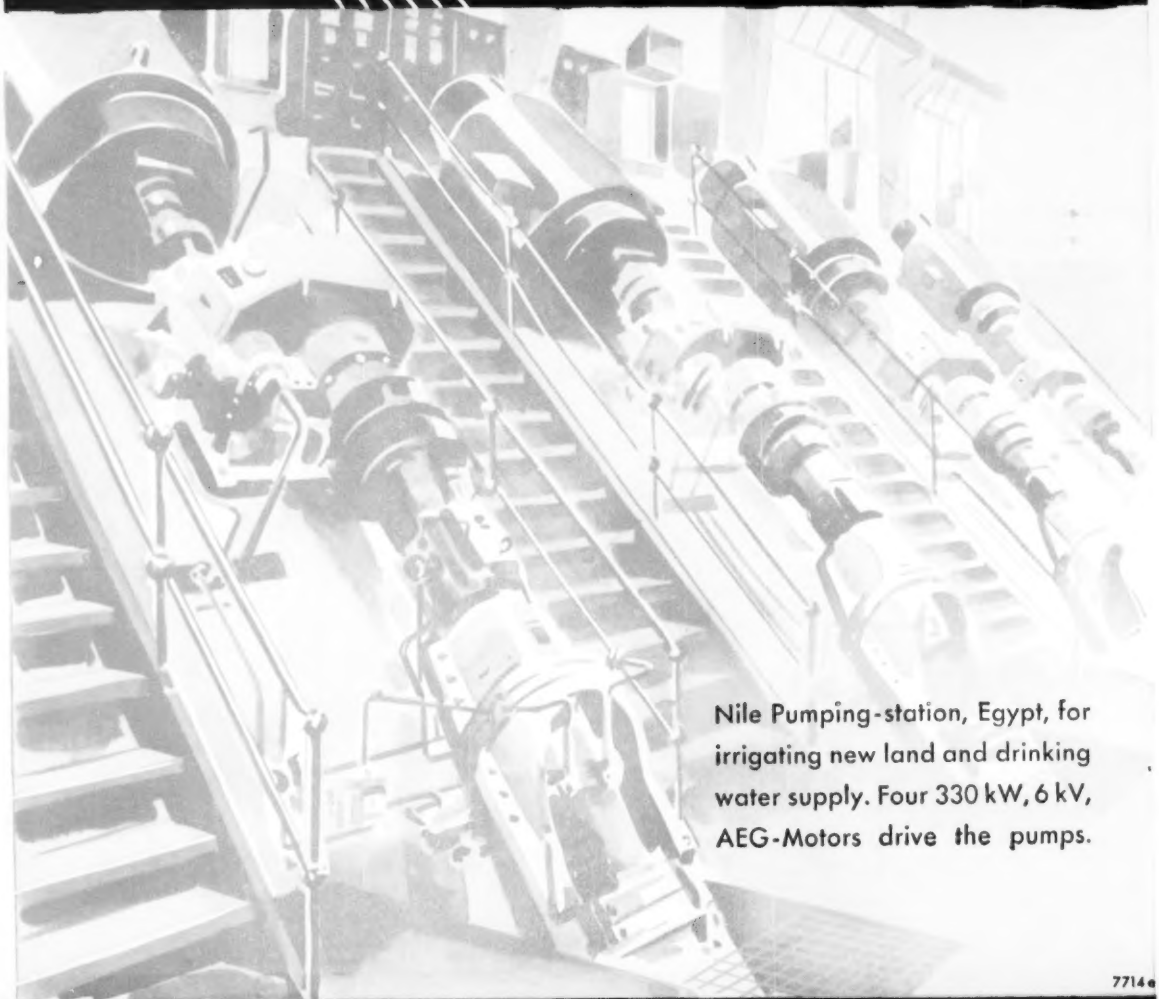


AEG

Irrigation Plant

Where flooded areas are to be reclaimed or arid, unfertile land irrigated, electrical power provides an invaluable aid – and where AEG electrical equipment in the pumping stations plays its important role.



Nile Pumping-station, Egypt, for irrigating new land and drinking water supply. Four 330 kW, 6 kV, AEG-Motors drive the pumps.

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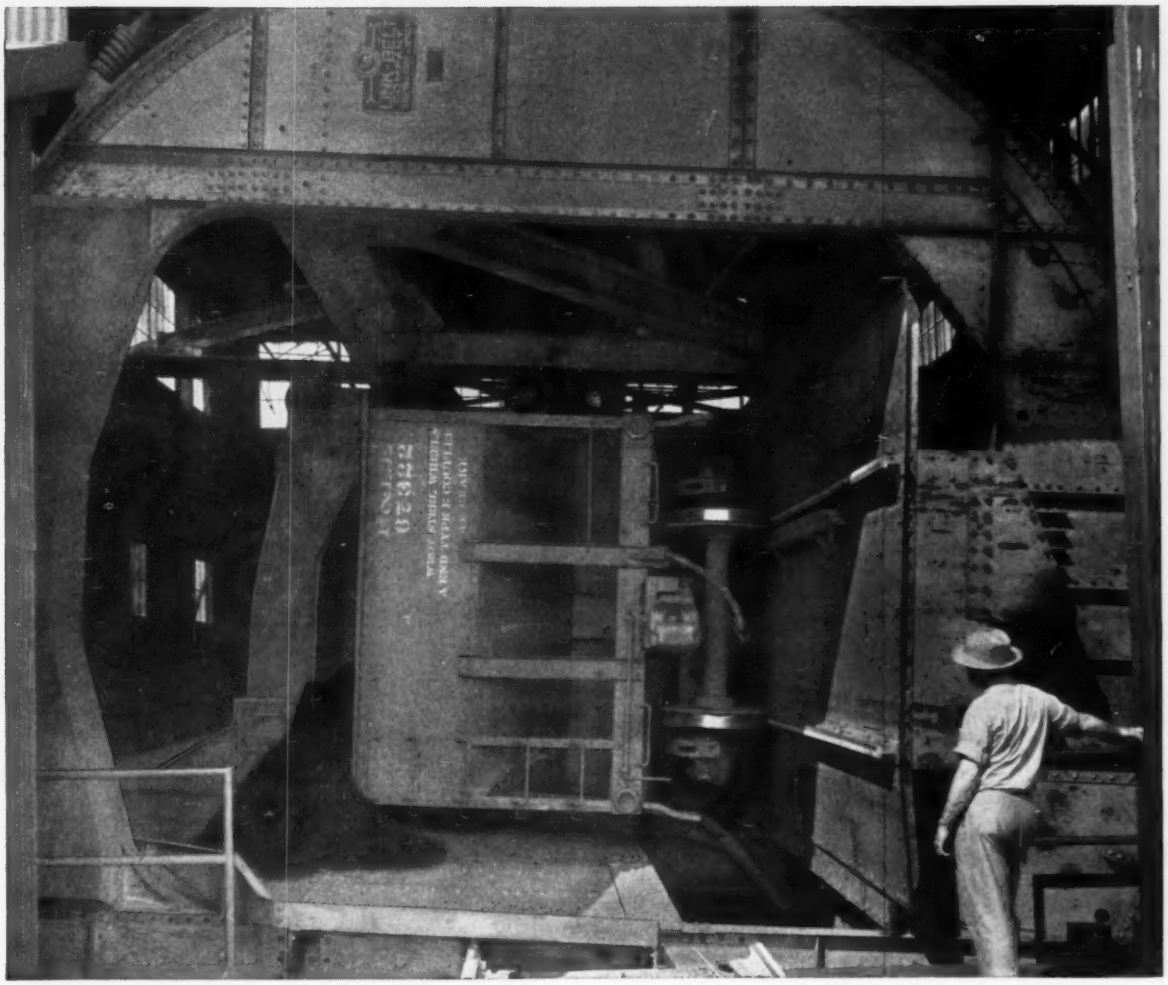
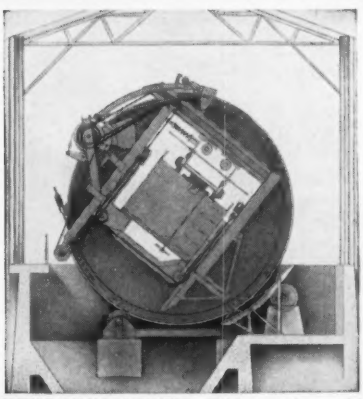
ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT

Berlin (West) EXPORT DEPARTMENT Frankfurt (Main)

BOTTOMS UP





DUMPING CYCLE IS SIMPLE. With car in position, rotation is controlled by means of lever. As car begins to tilt, the transfer table moves sidewise until side of car rests against it. Simultaneously, overhead self-adjusting clamps descend on top of car and hold if securely to rails. Rotation continues until car is overturned. Dumper is automatically stopped by limit switch. Pushing lever in opposite direction returns the dumper to normal position.

LINK-BELT rotary car dumpers empty 90-ton gondola cars in 60 seconds

One minute and one man—that's all it takes to unload a carload of coal with a Link-Belt rotary car dumper. The entire operation is lever controlled—permits unloading of 15 or more cars per hour including normal spotting and handling time. This foolproof system handles gondola cars of all sizes, with capacities up to 90 tons . . . cuts costly demurrage charges . . . minimizes operational hazards and accidents. For facts, call your Link-Belt office. Write for Book 2048-A.

LINK-BELT

ROTARY CAR DUMPERS

14.570

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3 dependable products for the diesel industry

DE LAVAL IMO PUMPS

De Laval IMO pumps do a dependable job during long years of service. The reason is IMO design simplicity. De Laval IMO's have only three moving parts—smoothly intermeshing rotors that propel the fluid axially in a steady flow without churning, pocketing or pulsation. There are no reciprocating parts to wear or become noisy. Quiet, compact IMO pumps are excellent for direct-connected, high-speed operation. They can be furnished in capacities to 1,000 gpm and pressures to 1,500 psig.

DE LAVAL HYDRAULIC FAN DRIVES

De Laval Hydraulic Fan Drives for air cooled heat exchangers and cooling towers offer these important advantages. They *save* power since the fan operates at full speed only a portion of the time. They provide *accurate, automatic* control of engine jacket water temperature, and also assure complete operational flexibility. These units stay on the job for years. As shown, both IMO motor and speed reducer are mounted and factory aligned on a single bedplate.

DE LAVAL HIGH PRESSURE TURBOCHARGERS

De Laval turbochargers offer pressure ratios of 3:1 as well as higher compressor and turbine efficiencies than those found in conventional turbocharger systems. Output of heavy duty diesel, gas and dual-fuel engines may be doubled by De Laval turbochargers without increasing thermal loading. Exclusive Monorotor design offers a compact lightweight unit of sturdy construction. De Laval turbochargers are self-adjusting to engine loads, can be used on 4- *and* 2-cycle engines.

You'll find additional data in these De Laval Bulletins. Write for your copies.

DE LAVAL

Steam Turbine Company

TRENTON 2, NEW JERSEY

Power

JUNE 1957 • VOLUME 101 NUMBER 6

SNOW OR SUN? Today's heat pumps take them both in stride. The busy executives and secretary, pictured on this month's cover, go about their jobs in an atmosphere of year-round conditioned air, supplied by heat pumps. Available designs—their pros and cons—plus reasons for the growing heat-pump market get the full editorial treatment, beginning on page 73.

ENGINEERING AND MANAGEMENT

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Next month . . .

Germanium rectifiers are cast to play a major role in the growing industrial need for dc power. It's estimated that 20 to 25% of ac generated in U.S. is converted to dc power before it's consumed. New electrolytic processes and precise speed-control demands are pushing this figure higher. Upcoming article spots some significant trends.

Turbine steam piping poses special problems that must be solved in setting up a trouble-free installation. First of a 2-part article reports standards approved by the National Electrical Manufacturers Association.

On-the-job training, visual-aid variety, is strictly top drawer at Kodak Park, utilities division. They team photography, indexed binders, experienced operators to turn out highly skilled personnel. Coming in July.

. . . and a future month

Viscosity classification is headed for streamlining if recent action of steel people and ASLE bear fruit. Forthcoming article has full facts.

Print order this issue: 49,132

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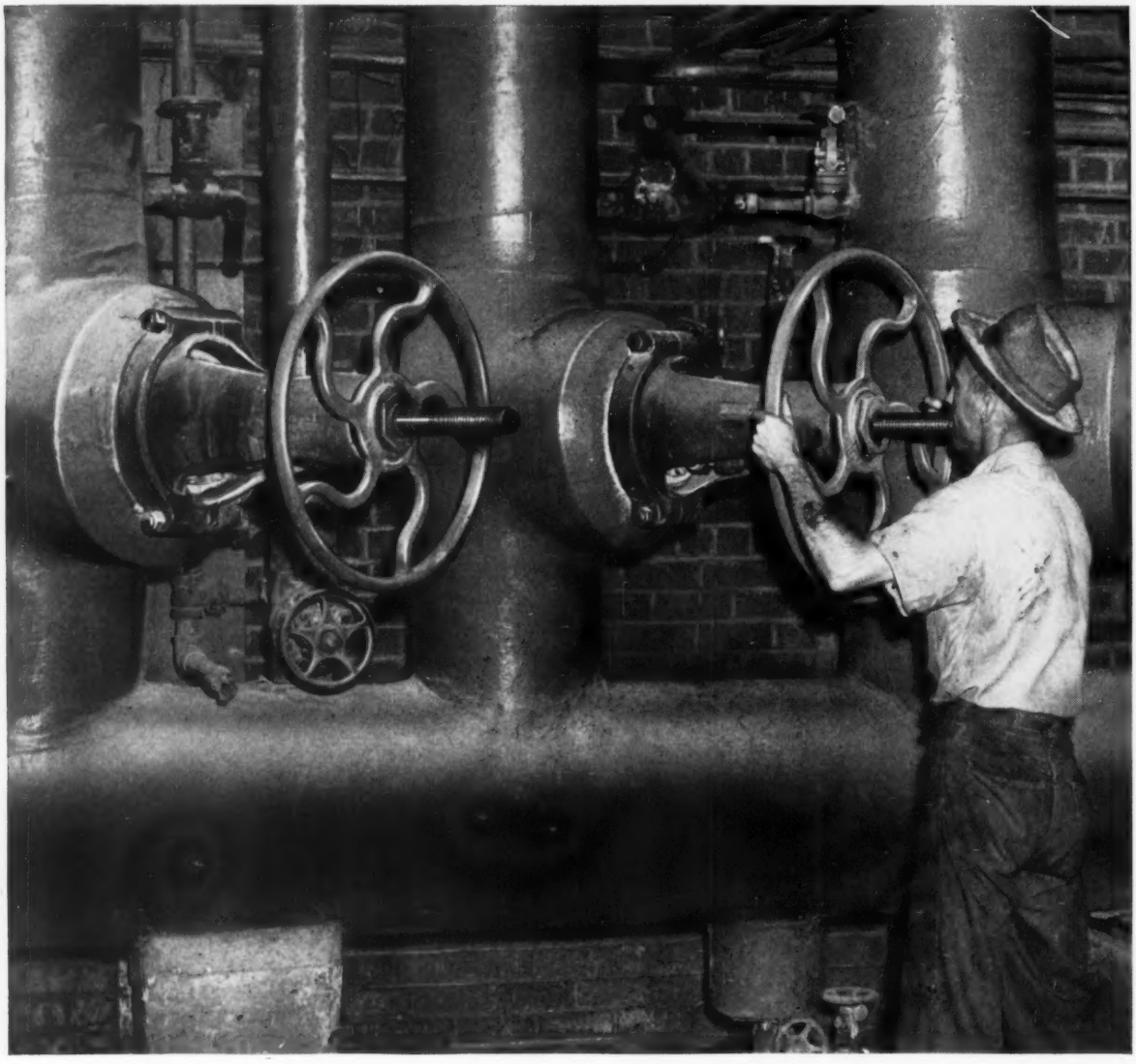
No Bonnet-Joint Maintenance—No Bonnet-Joint Leakage



These valves helped the maintenance crew win a losing battle

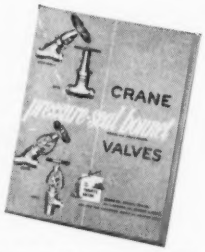
This process industry plant saw the danger signal. Servicing leaky valve bonnet joints was taking too much time. Other important maintenance work was being neglected.

That's why, in 1947, when expanding the power plant, Crane Pressure-Seal Bonnet Gates were chosen for main steam service as shown above. Working pressure: 600 psi at 725 deg. F.

These Crane valves need no bonnet joint maintenance. The joint is leakproof—sealed tight by internal fluid pressure. Crane alloy seats and flexible wedge disc make closure tight and easy.

To date, the Crane Pressure-Seal Gates have given this plant over 9 years' uninterrupted service. The maintenance crew hasn't touched them except for routine care.

Full information on these modern power service valves is given in Circular AD-1936. Get a copy from your Crane Representative or by writing to address below.



Ask for Circular AD-1936

CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

speaking of **Power**

Blueprinting editorial plans for tomorrow . . . and what it means to you

Setting goals for our 76th year

With sun pouring over the south terrace of Columbia University's Arden House in Harriman, N. Y., a group of key business paper editors sat down to wrestle with the broad problem of planning ahead—what kind of long-range planning is practical . . . how to set up a working schedule for a successful planning program?

At about 3 pm, amid the comfortable surroundings of the former Harriman family estate, Managing Editor Jim O'Connor took the floor to outline POWER's approach to long-range report and article planning: What we're doing and how we're doing it.

Planning editorial goals falls, quite naturally, into setting long and short-range objectives. But just where does that fuzzy dividing line between short and long range fall? Perhaps the special report, a staff-written 20-year-plus veteran in POWER's pages, is one example of reasonably long-range planning. As O'Connor outlined before the editorial wing of the Associated Business Publications, we settle down to the early-planning stage of a special report some 12 months before the issue is published. With framework laid out, the specifics start to fall in place. We set the technical limits, check early plans with key engineers, rough out a preliminary outline and start the job of fact-gathering in the field. With all field info on tap, the big job of sifting and assembling begins. But the real hub is careful planning, in tune with the shifting editorial needs of readers.

There's a practical time limit on long-range planning, at least in the area of special reports. We find in this fast-changing power field, it's impractical to pin down a theme too far in advance. That's why we shoot for a 12-month gestation, often less because of subject urgency.

Article planning in contrast to special report blueprinting, follows a somewhat different tack. First off, it's generally on a short-range schedule. At a staff meeting of technical editors we scrutinize, collectively, the outcroppings in each of the power services. Here we determine which areas we will concentrate on in the immediate months ahead.

Typical: Right now there is some activity in technical circles regarding the possible adoption of a simplified system for viscosity classification of industrial lubricants. If such a scheme is adopted by both supplier and user of lubricants, it will mean some changes in reader buying habits. When to run such an article? Who should write it? These two questions must be answered. Then the article is scheduled, based on the practical matters of space limitations, subject urgency.

Successful planning shows results in several ways. It leads to a more useful magazine. We tune in on this angle in our monthly readers' surveys covering every article in each issue. Occasionally recognition comes in the form of kudos from our peers in the editorial profession. Perhaps the most satisfying form of recognition comes in knowing we are moving into our 76th year of publishing with a planned approach for meeting tomorrow's editorial needs.

Recognition of a somewhat different nature has come to one of POWER's readers. In researching for our 75th Anniversary Issue, coming in September, we stumbled over the interesting fact that Herman Fischer of Holyoke, Mass. has subscribed to POWER continuously for over a half century. Do you know of a continuous subscriber predating 1907?

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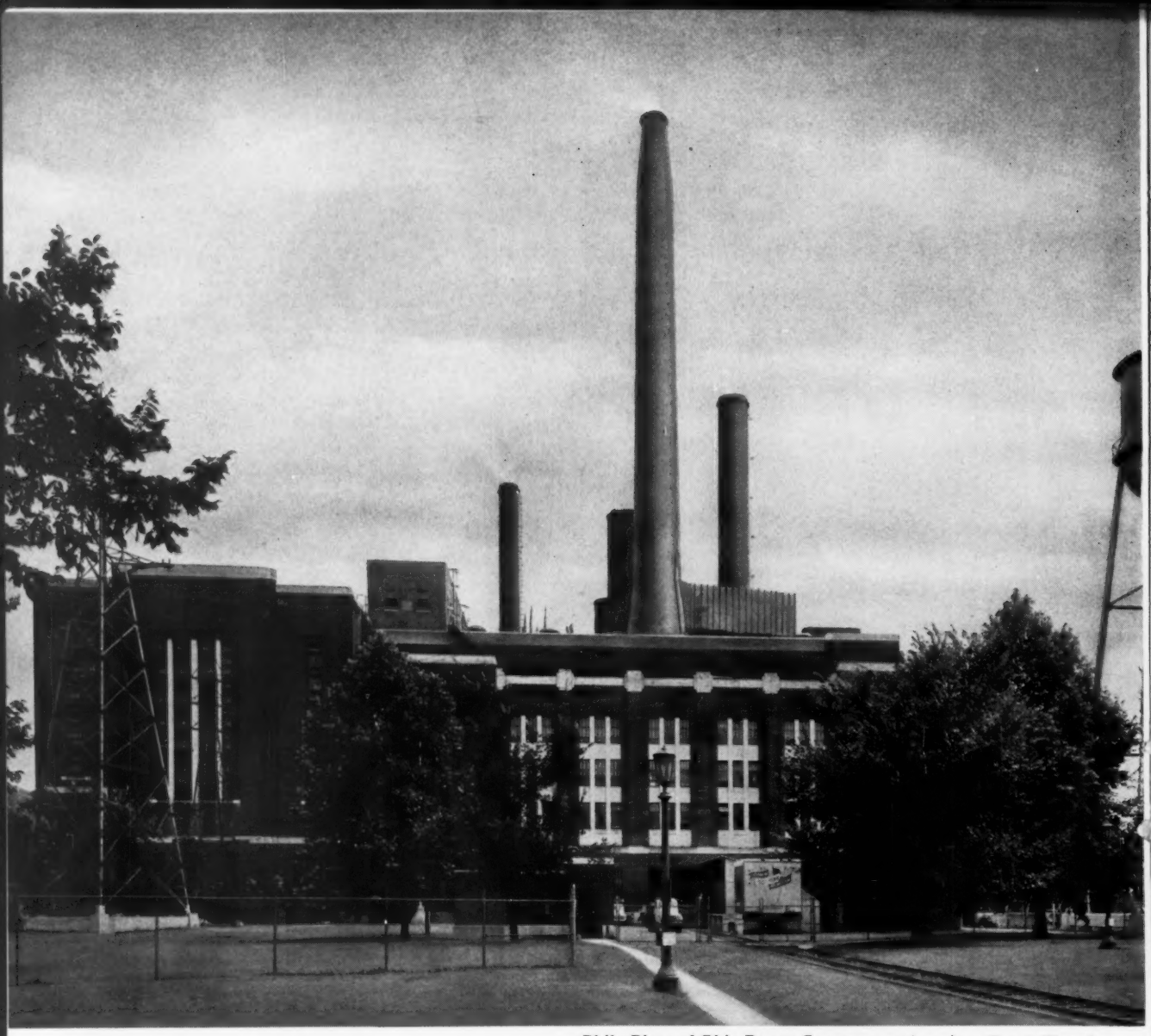


Philo Plant of Ohio Power Company on American Gas & Electric System. Stack in front is for the new Supercritical Unit.

B&W's Universal Pressure Steam Generator

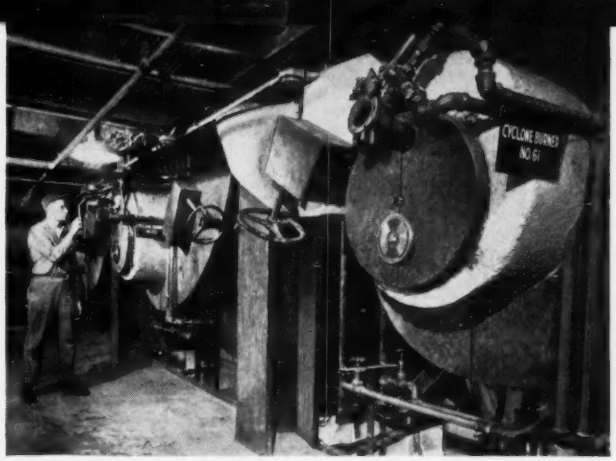
Helps Philo Plant Open the Way to New Economies in Steam-Electric Generation

Generating history is being made at the Philo Plant of the Ohio Power Company on the American Gas & Electric System. Here, America's first commercial supercritical pressure steam-electric unit is in operation, probing the frontiers for new economies in the production of energy.

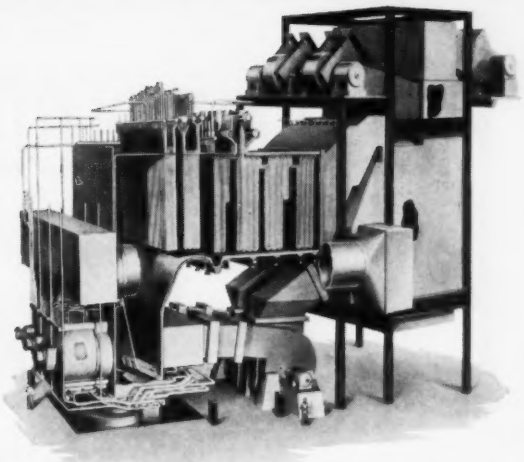
A Symbol of the Vision and progressiveness of America's public utilities and their suppliers, Philo is a landmark in engineering history. It is the result of years of engineering, research, and development that solved the many problems which had stood in the way of greater plant efficiency that comes with the highest possible combination of pressure and temperature.

The Problems Solved included the very difficult ones of feedwater chemistry, of heat transfer and control of internal deposits, metallurgy for higher temperatures combined with higher pressures, and development of control and operating techniques.

Philo's Supercritical Unit, with a turbo-generator operating at 4500 psi and 1150F, is producing over 120,000 kw, in the same space and using 45 per cent less fuel per kwhr than the 40,000 kw unit it replaced.

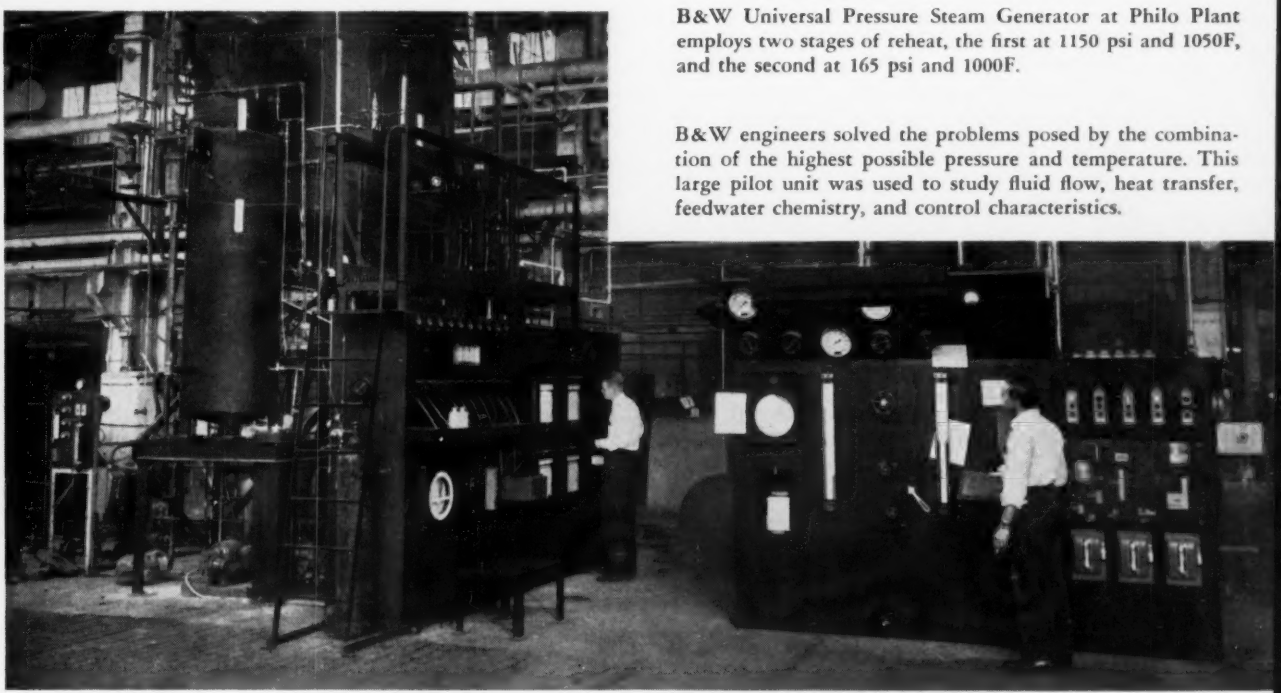


Three B&W Cyclone Furnaces assure rapid and complete combustion, with minimum fly ash discharge and maintenance.



B&W Universal Pressure Steam Generator at Philo Plant employs two stages of reheat, the first at 1150 psi and 1050F, and the second at 165 psi and 1000F.

B&W engineers solved the problems posed by the combination of the highest possible pressure and temperature. This large pilot unit was used to study fluid flow, heat transfer, feedwater chemistry, and control characteristics.



Two More B&W Universal Pressure Steam Generators are now being built for The American Gas & Electric System. Together these will produce 900,000 kw—enough to supply residential power for a city of 8,000,000. Like Philo, they will continue to push forward this new frontier in steam generation.

Nearly a Century of B&W leadership in steam generation stands behind these achievements. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

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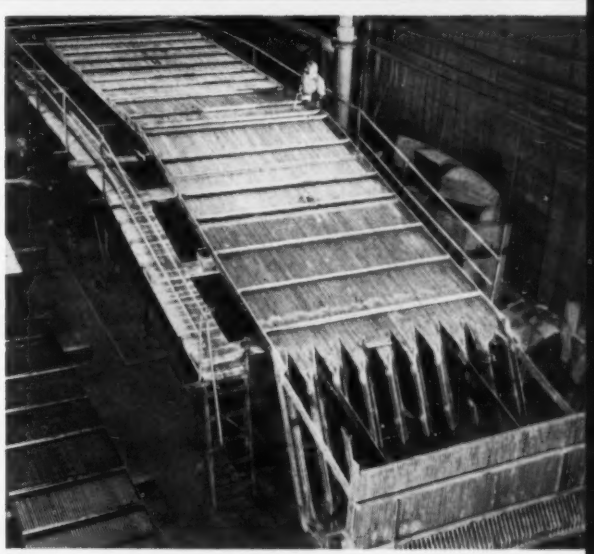
BOILER DIVISION



Shop assembly of secondary front wall. Pre-assembly of many components for the Universal Pressure Steam Generator greatly speeded field erection.

IMPROVED BLOWER NOZZLE and

more important features of the

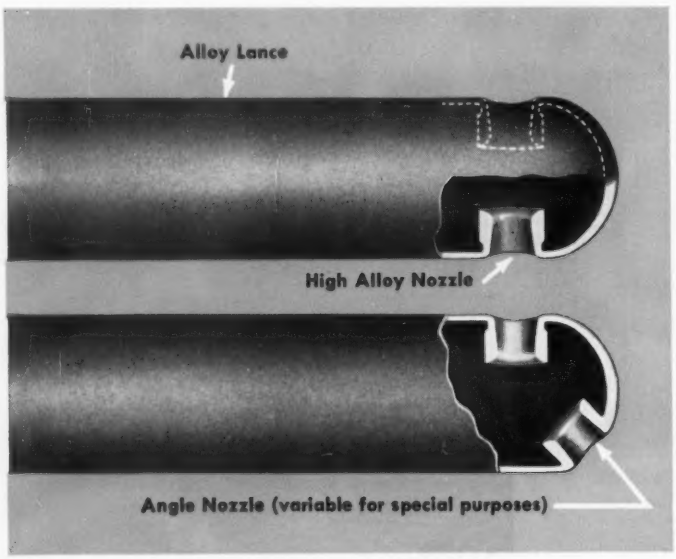
New Diamond Series 300 IK
LONG RETRACTING BLOWER

This improved nozzle provides more available cleaning energy per pound of steam or compressed air. A modified venturi, it is the result of extensive research during which more than 50 contours were tested.

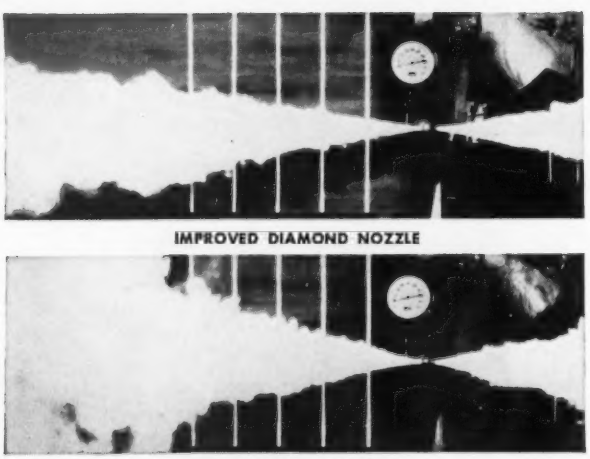
The positively-controlled, close helical cleaning pattern assures optimum coverage of the heating surface.

Return travel path is exactly intermediate to forward travel path . . . resulting in a positive nozzle sweep every inch.

These features are two of many reasons why the Diamond Series 300 IK Blower does a better and more economical job of cleaning surfaces which require a long retracting blower. Other advantages are listed at the bottom of the opposite page. Ask the nearest Diamond office for Bulletin 2111 which will tell you much more about the new Series 300 IK.



Improved Diamond Type "A" Nozzle has low approach velocity for optimum nozzle performance (see curves below). It provides greatest impact for any given blowing pressure . . . means greater effectiveness and economy.



IMPROVED DIAMOND NOZZLE

SIMPLE VENTURI NOZZLE

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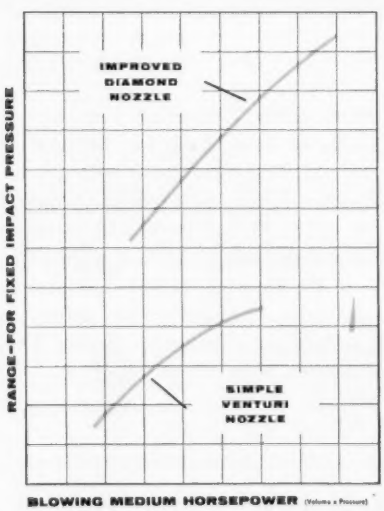
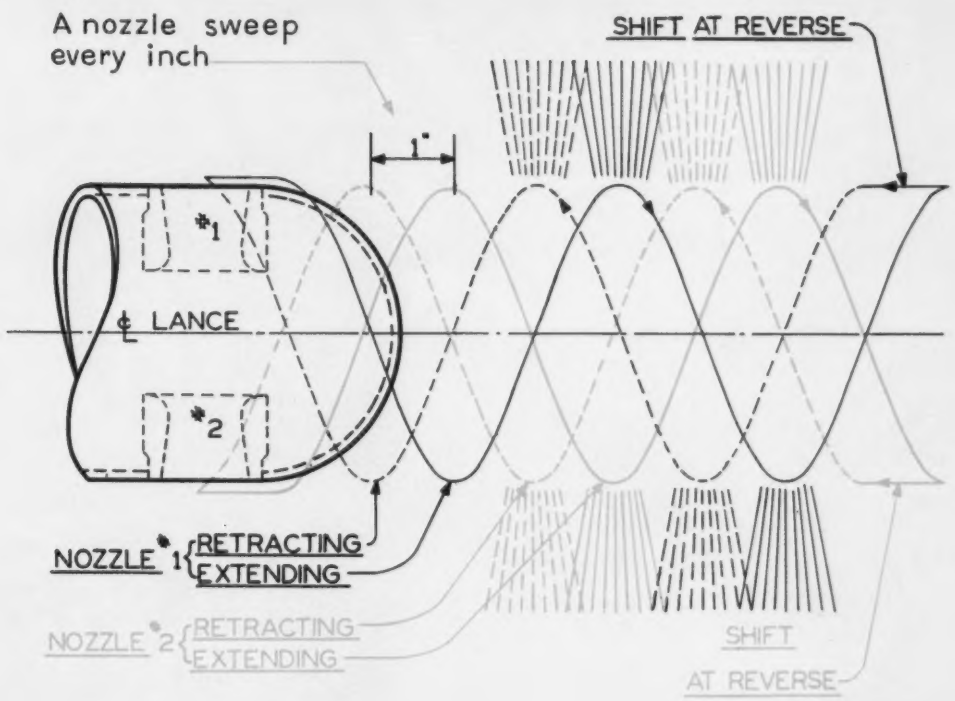
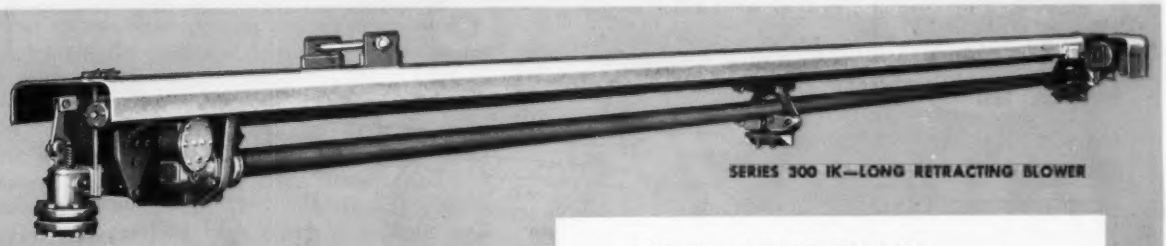

IMPROVED DIAMOND NOZZLE
SIMPLE VENTURI NOZZLE
RANGE—FOR FIXED IMPACT PRESSURE
BLOWING MEDIUM HORSEPOWER (Volume x Pressure)

Note the greater blowing range of the improved Diamond Nozzle when compared with a simple venturi nozzle under identical test conditions.

IMPROVED CLEANING PATTERN



Nozzle-sweep-every-inch blowing pattern assures COMPLETE coverage of ALL surface EVERY time



SERIES 300 IK—LONG RETRACTING BLOWER

DIAMOND POWER SPECIALTY CORPORATION

LANCASTER, OHIO

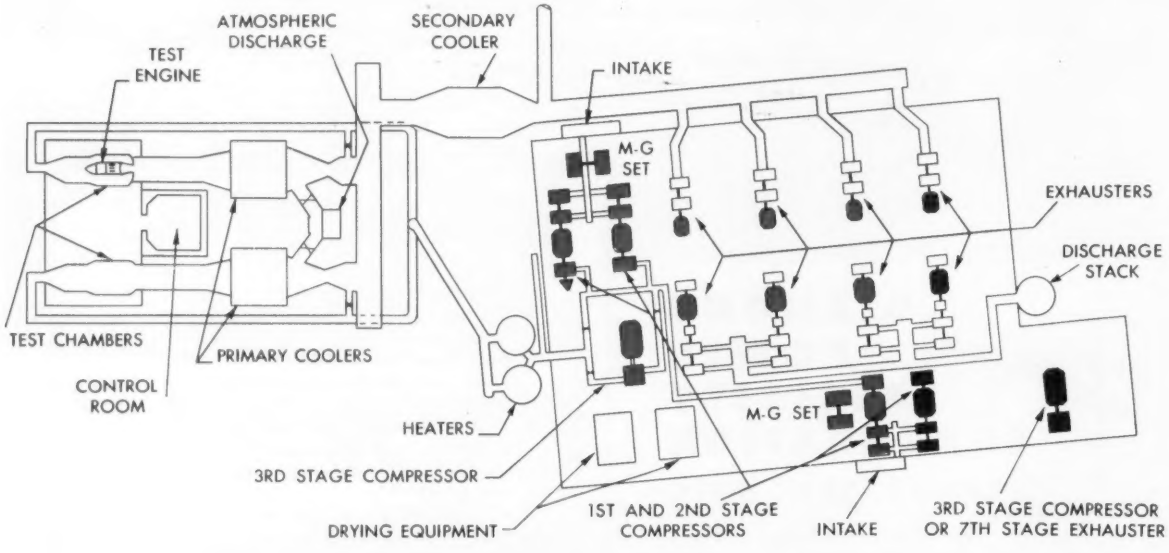
Diamond Specialty Limited
Windsor, Ontario

OTHER ADVANTAGES OF SERIES 300 IK BLOWERS

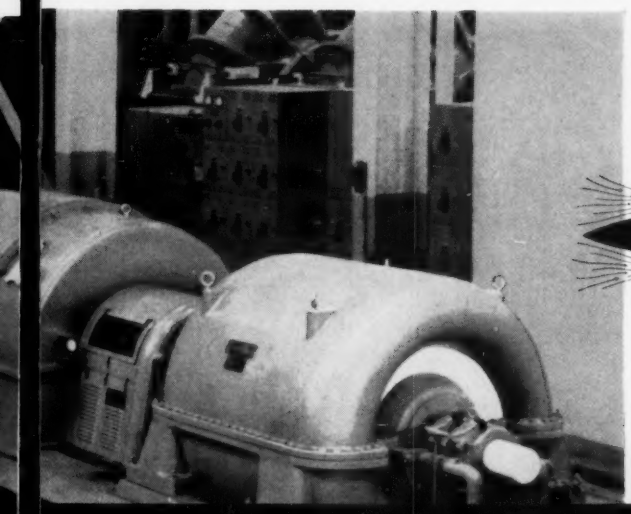
- Backbone and Protective Cover
- Front End Single-Motor Drive
- Compact, Accessible Electric Power and Control Terminal Facilities
- Positive Gear Carriage Drive
- Poppet Valve with Adjustable Pressure Control
- Positive Mechanically Operated Valve
- Single Point Outboard Suspension
- Oversize Lance (Step-Tapered for Extra Long Travel)
- Auxiliary Carriages for Extra Long Travel
- Designed for Quick, Easy Servicing

No other blower gives you all these advantages.

Each line of Elliott combustion air compressors (two are shown above) involves three casings. There are two first-stage casings with a total atmospheric inlet capacity of 106,000 cfm, discharging at 29.6 psia to the inlet of the second stage, which discharges at 60 psia. Unit at left shows, in the foreground, an Elliott radial in-flow expander. Behind the expander is the second-stage compressor, then the 16,500-hp, 3600-rpm synchronous motor, and beyond that are the two first-stage casings. In the background is the Elliott motor-generator set, a 5000-hp, 900-rpm wound-rotor induction motor driving a 4650-kva, 720-rpm alternator used for starting the synchronous motors.



In this layout of Propulsion Systems Laboratory, Elliott equipment already installed is indicated in orange. Elliott equipment on order and to be installed in the near future is indicated in solid black.



ELLIOTT COMPRESSORS AND MOTORS speed the nation's research at NACA's Lewis Flight Propulsion Laboratory

TO ACCELERATE important aircraft propulsion research, the National Advisory Committee for Aeronautics constructed the Lewis Flight Propulsion Laboratory in Cleveland. Testing facilities in the Propulsion Systems Laboratory at Lewis simulate jet engine speeds up to Mach 3 (three times the speed of sound at any given altitude) and altitudes above 60,000 ft.

To help create a wide range of in-flight conditions, important Elliott compressor and electric equipment has been installed. This includes Elliott combustion air compressors, and large 3600-rpm synchronous motors. In fact, to date the horsepower of Elliott motors installed and on order totals over 218,000, and the capacity of Elliott centrifugal compressors, over 359,000 cfm.

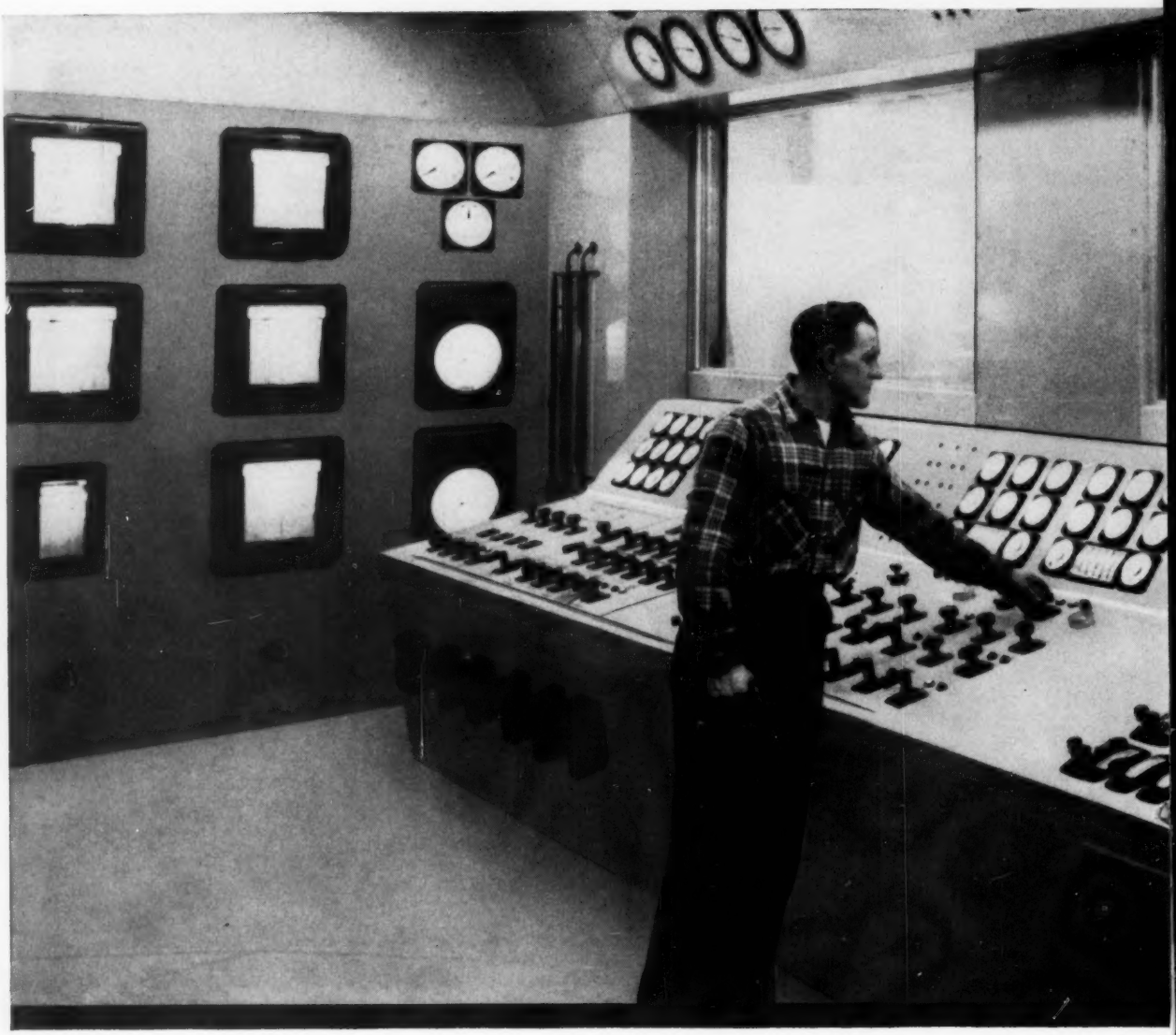
For information on how Elliott quality products can help you, call the nearby Elliott District Office, or write Elliott Company, Jeannette, Pa.

One of a line of three Elliott 10,000-hp, 3600-rpm synchronous motors which drive the second- and third-stage exhausters.

ELLIOTT Company

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS
CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

Q7-2



How Bailey helps you get a new

The thrill of putting a new station "on-the-line" can be marred if steam plant meters and controls don't work smoothly, efficiently. You are a lot surer of a fast, safe start and dependable operation for a long time when you specify Bailey Meters and Controls. They are keys to peak efficiency and low operating costs.

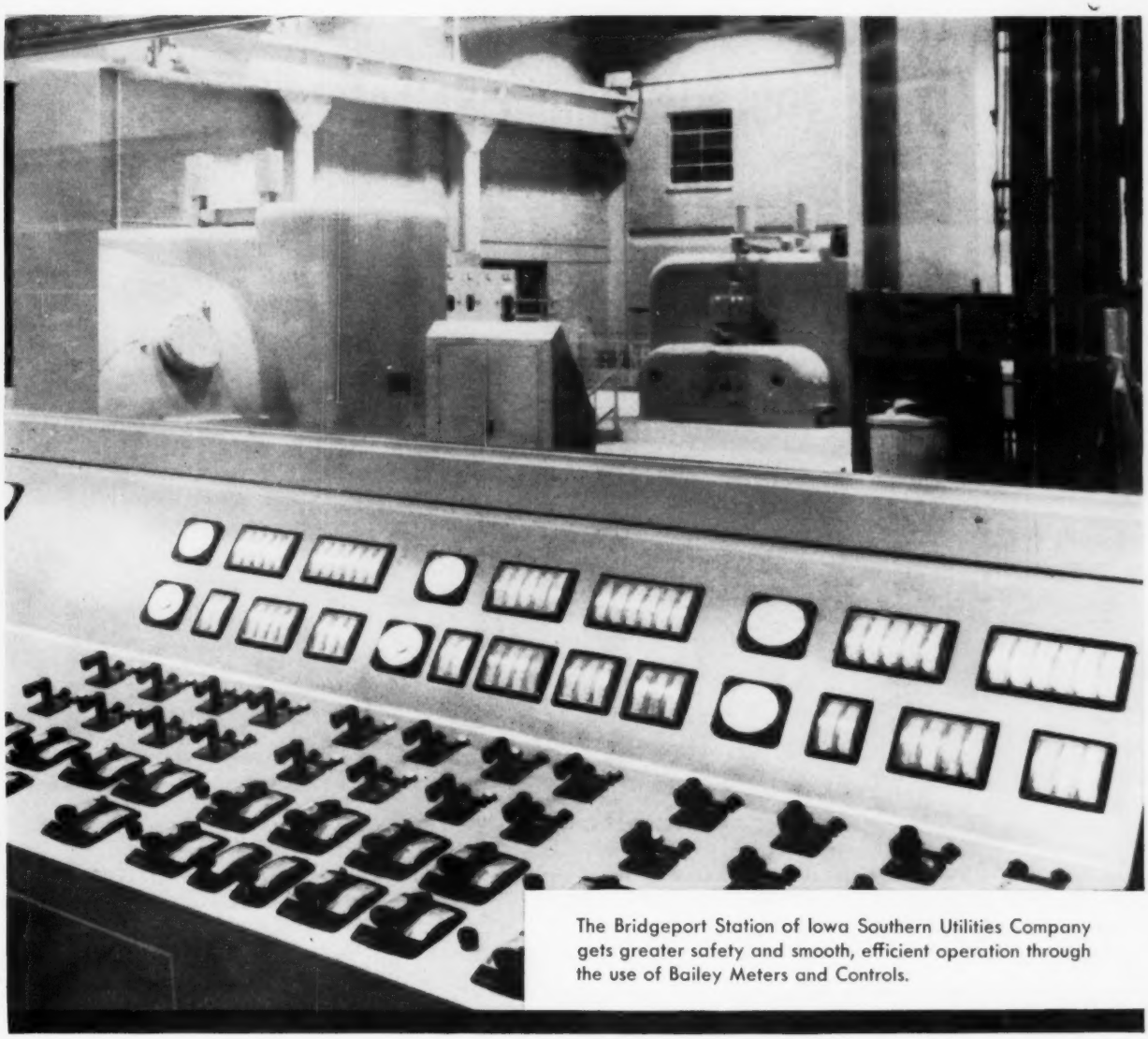
Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs. Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work more efficiently for more than forty years. Veteran engineer and young engineer alike, the men



The Bridgeport Station of Iowa Southern Utilities Company gets greater safety and smooth, efficient operation through the use of Bailey Meters and Controls.

station off to a fast, safe start

who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

A131-2

BAILEY METERS

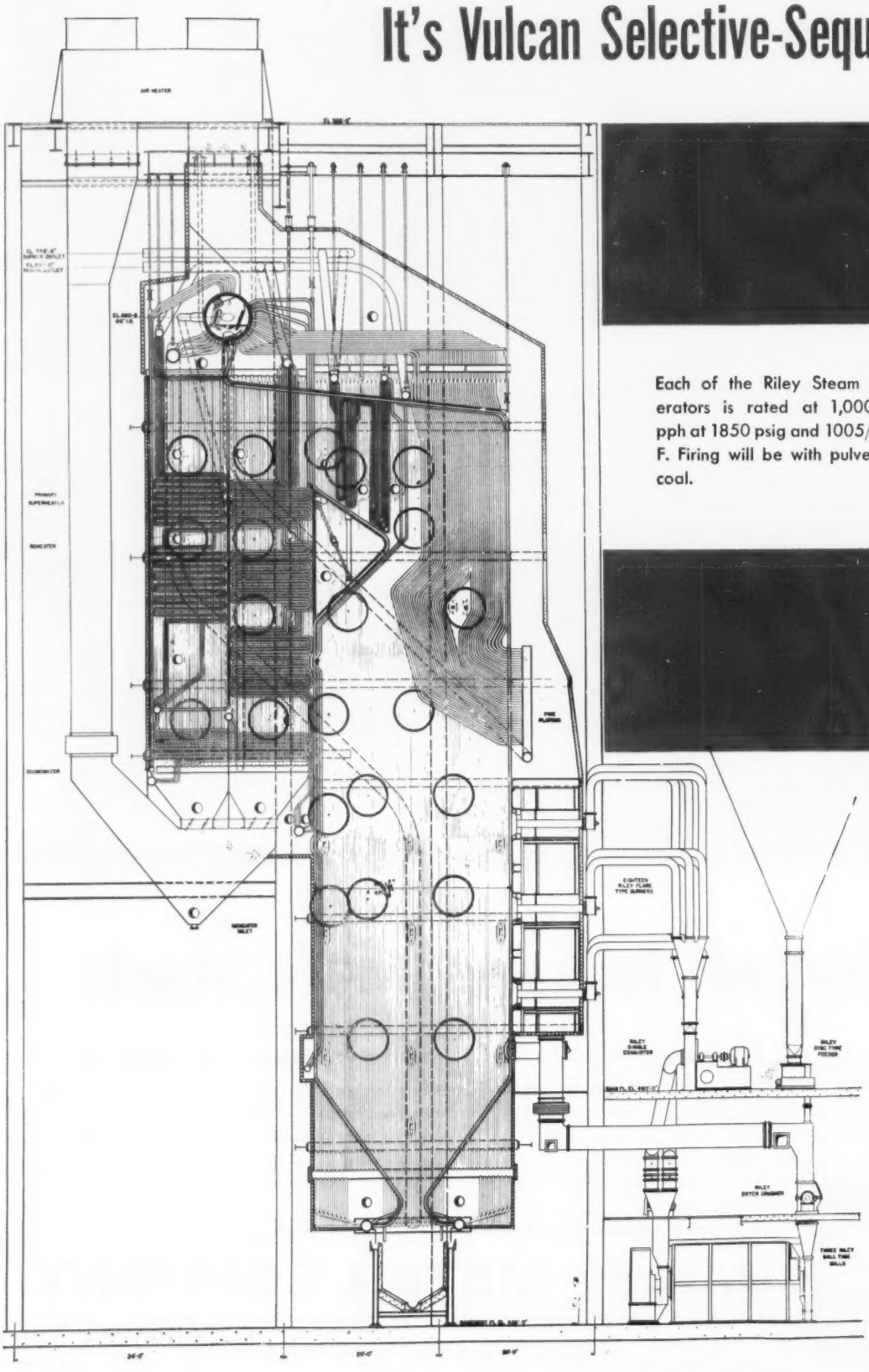
Instruments and controls for power and process

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

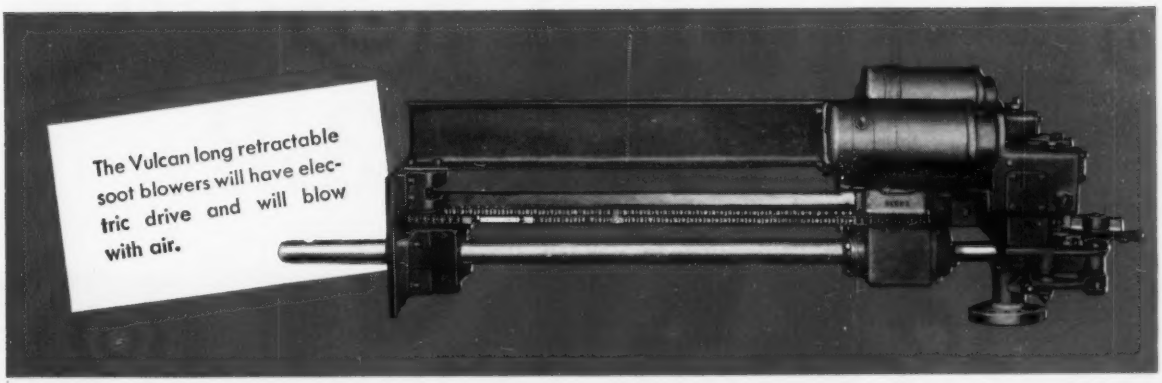
In Canada—Bailey Meter Company Limited, Montreal

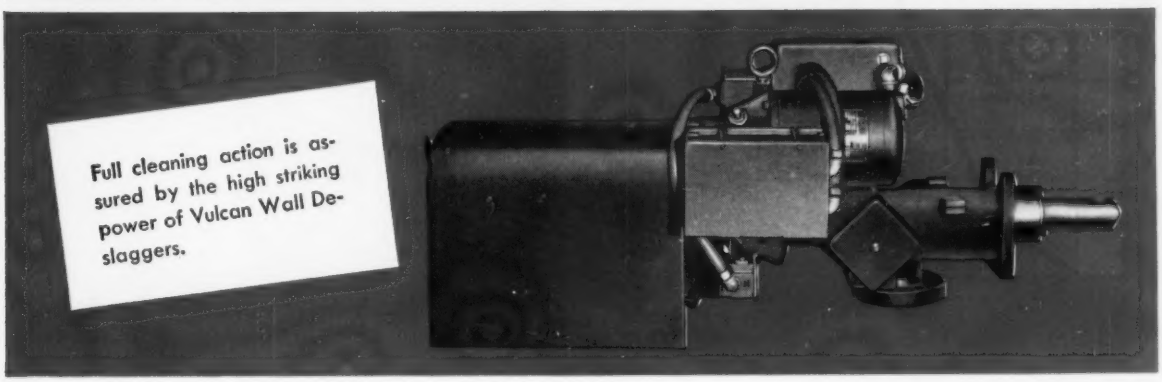
It's Vulcan Selective-Sequence



Each of the Riley Steam Generators is rated at 1,000,000 pph at 1850 psig and 1005/1005 F. Firing will be with pulverized coal.

at New Albany Generating Station





Boiler cleaning systems for Units 1 and 2 in the New Albany Station of Public Service Company of Indiana will be under Vulcan Selective-Sequence Control. Each of the two Riley Steam Generators will be equipped with a Vulcan Soot Blowing System which includes Long Retracts and Wall Deslaggers.

Selective-Sequence operation of the soot blowing system was chosen to give positive operation at proper intervals in precisely the sequence necessary for the most effective cleaning. Vulcan Long Retractable Soot Blowers with two motor operation assure maximum coverage with uniform cleaning of all surfaces. Vulcan Wall Deslaggers deliver maximum striking power to drive off slag, assuring high heat-transfer capacity and uniform control of superheat and reheat temperatures.

Modern soot blowing systems, with either automatic-sequential or selective-sequence control, can help keep your boilers operating at peak efficiency. Whether your boiler is power or process, large or small, investigate Vulcan Automatic Soot Blowing Systems for better cleaning results.

COPES-VULCAN DIVISION

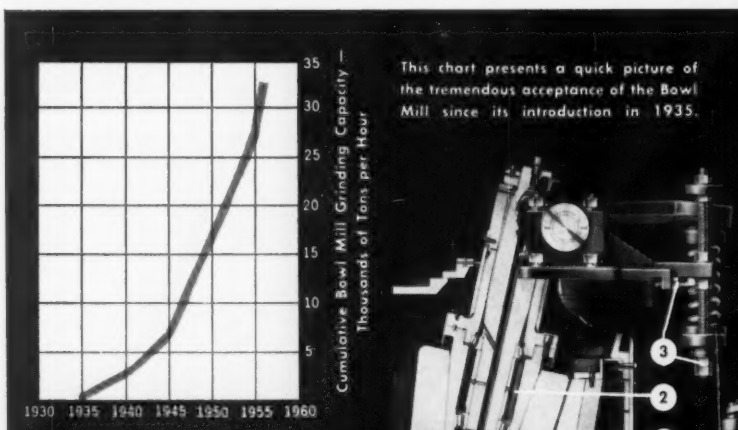
BLAW-KNOX COMPANY

ERIE 4, PENNSYLVANIA

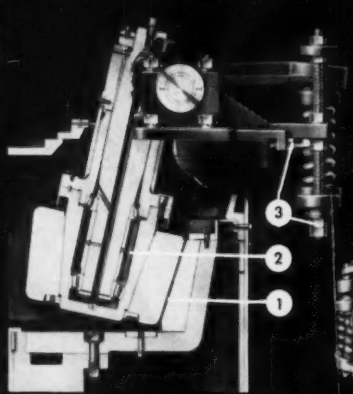
50th Anniversary BLAW-KNOX 1906-1956

Why the Bowl Mill is

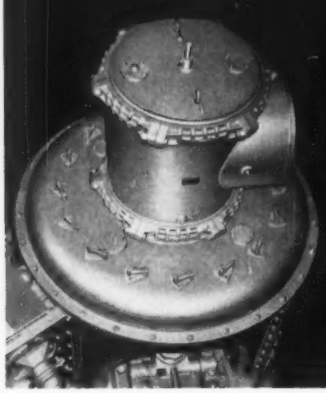
AMERICA'S No. 1 PULVERIZER



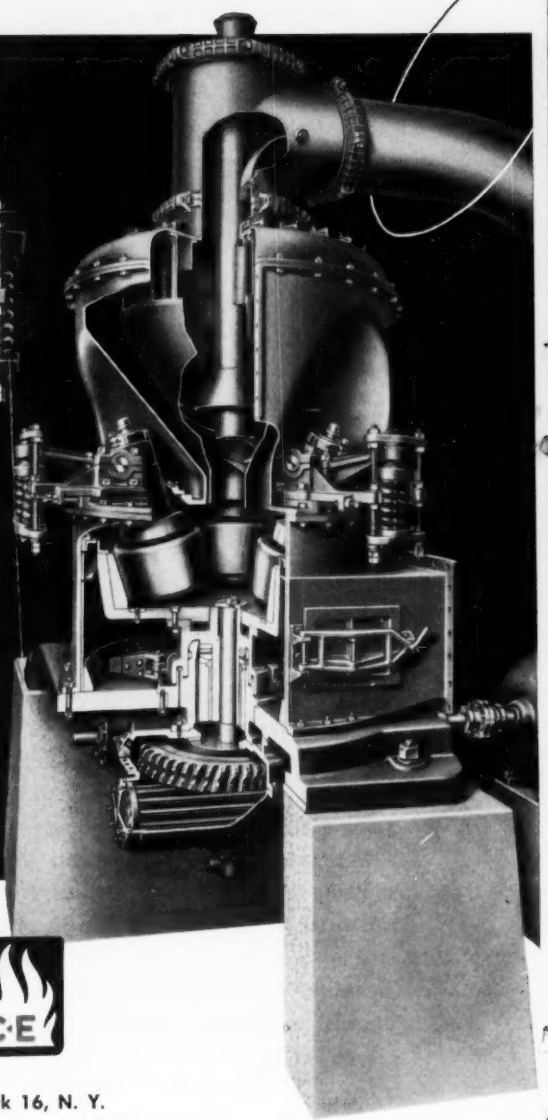
This chart presents a quick picture of the tremendous acceptance of the Bowl Mill since its introduction in 1935.



Cutaway view showing assembly of roller journal in bowl. Note: 1 — no metal-to-metal contact; 2 — self contained lubrication system (no grease cups); 3 — convenient method of adjustment without dismantling.



Looking down on top of mill. See handy arrangement of levers which adjust vanes — while in operation — to control fineness of coal leaving mill.



COMBUSTION ENGINEERING

C-E

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

Canada: Combustion Engineering-Superheater Ltd.

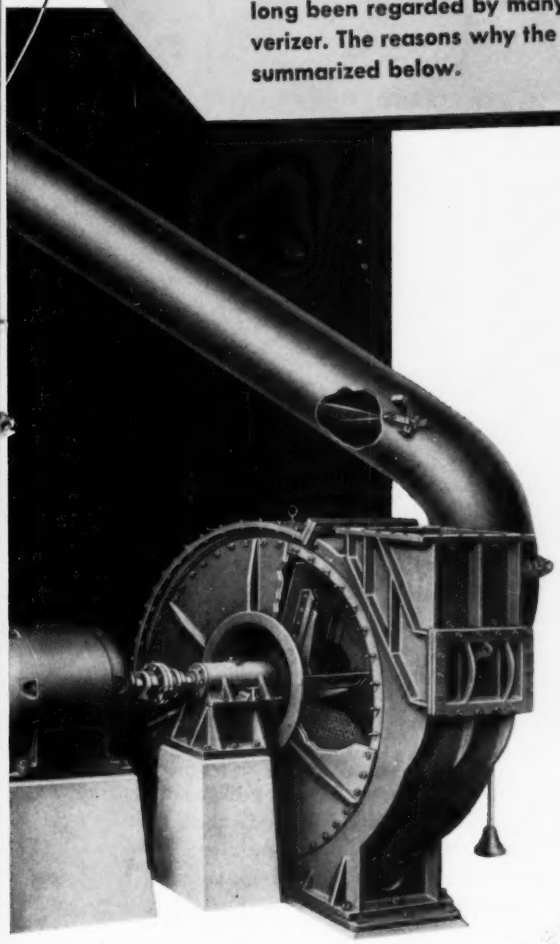
B-987

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

A first-class pulverizer should possess certain basic capabilities of which the following — most operators will agree — are the most important. They are the ability to . . .

- ***handle high moisture fuels without difficulty***
- ***operate with low power requirement***
- ***stay in continuous service for long periods***
- ***operate with low maintenance costs***
- ***permit convenient control of fineness while running***
- ***adjust grinding pressure automatically***
- ***lubricate, when required, while in operation***
- ***operate quietly and without vibration***

It is because the C-E Raymond Bowl Mill measures up on *all* these points that it has long been regarded by many leading power engineers as the country's No. 1 pulverizer. The reasons why the Bowl Mill is an outstanding all-around performer are summarized below.



HIGH MOISTURE — The most effective means of achieving good pulverizing results with high moisture fuels (16 — 18% — Eastern coal, 24% Midwestern, 45 — 50% lignites) are (1) by the admixture of fuel already dried in the mill with the raw feed and (2) by the use of high temperature air. The C-E Raymond Bowl Mill was designed to do both of those things, and does them well. Air temperatures of 700° F. and above can be utilized.

LOW POWER CONSUMPTION — Basic design characteristics of the Bowl Mill permit pulverizing at less power per ton of material than any mill now available. The rapid flow of material through the mill and the prompt removal of fine coal as it is produced prevents over-grinding. This, in conjunction with the relatively low mass of grinding elements and rapid drying action in the mill, assures minimum power consumption.

RELIABILITY — Design and materials are responsible . . . but results prove the point — such results for example as operating records of 8500, 10,000, 15,000, 20,000 continuous service hours without repair or replacement of parts.

MAINTENANCE — Bowl Mill maintenance cost has always been the lowest in the field. Continuing improvements in designs, materials and construction keep it that way. A minimum of outage time is required for dismantling and assembly. It's a matter of record in many plants that higher costs of material and labor over the past 15 years have not been reflected in increased maintenance cost per ton of coal pulverized.

FINENESS CONTROL — All necessary adjustments to control fineness of finished product can be made conveniently from the outside of the pulverizer *while it is in operation.*

AUTOMATIC GRINDING PRESSURE — The arrangement of spring-loaded roller journals on the Bowl Mill provides automatic compensation for the variation in pressure between grinding surfaces required by variation in grindability of coals.

LUBRICATION — Is no problem with the Bowl Mill. When required — at infrequent intervals — all lubrication is handled from outside the mill while it is in service.

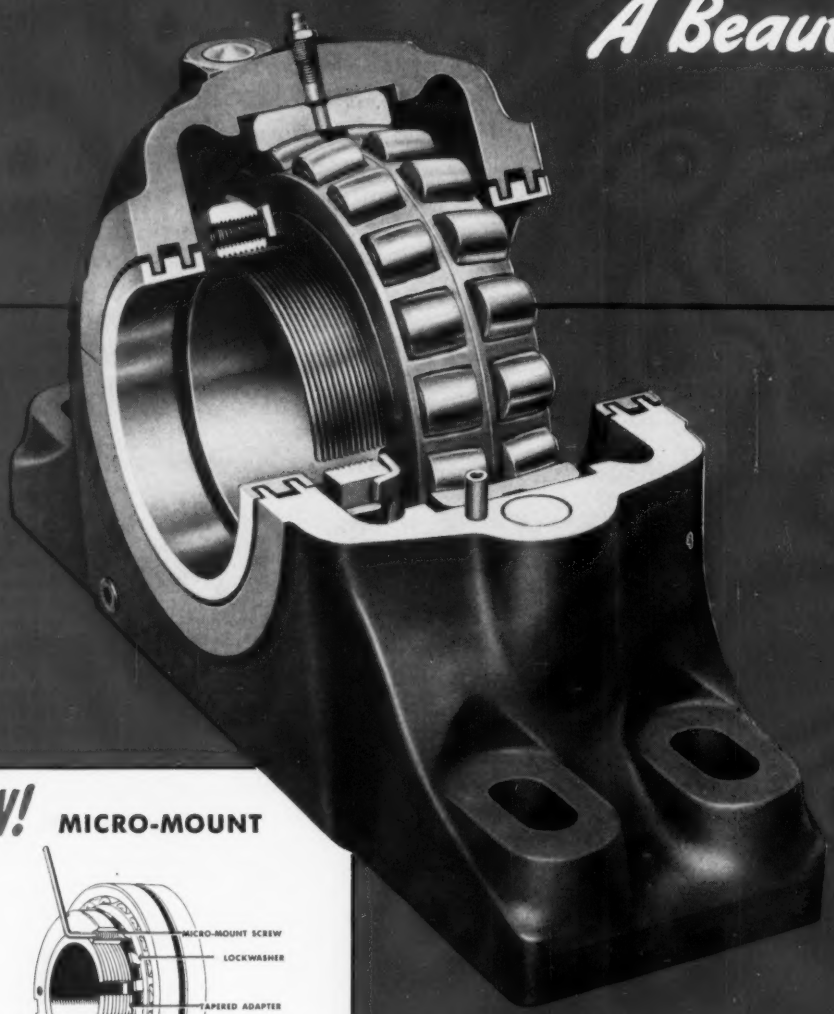
VIBRATIONLESS — QUIET — The Bowl Mill's grinding rollers make no metal-to-metal contact with the grinding ring, assuring quiet, vibrationless operation.

• • •

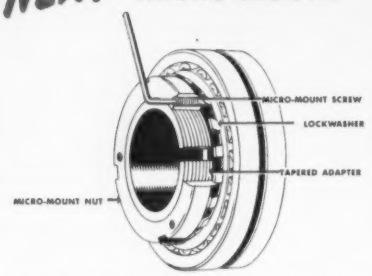
Whether you are evaluating pulverizers for your present plant expansion program or for future requirements, we suggest you use the above check list to get the facts. Send for Catalog PC-8 for further details.

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

A Beautiful



NEW! MICRO-MOUNT



Fast and accurate mounting is made possible by the new Dodge Micro-Mount. The Adapter is snugged up with the Micro-Mount Nut. Mounting is completed by turning the Micro-Mount Screws against the Lockwasher until bearing, adapter and shaft form an integral unit.

Now — a spherical roller bearing pillow block has been added to "America's most complete line of mounted bearings."

This new Dodge product possesses all the fine characteristics of the spherical type, plus the precision, dependability and refinements you would expect from the nation's leading supplier of mounted bearings.

Rugged housing of close-grained semisteel, in compact modern design, withstands shock loads. The new Micro-Mount Adapter seats Spher-Align solidly on shaft, *with amazing ease and speed.* A new feature of bearing design allows lubricant to enter at center of bearing and move outwardly along all bearing surfaces. Convenient drain plugs permit use of either grease or oil and provide for easy flushing. Triple seals retain lubricant.

Standardized dimensions make Spher-Align interchangeable with all other similar units. Available in expansion and non-expansion types. In stock for 2 7/16" to 8" shafts. Call your Dodge Transmissioneer — or write us.

DODGE MANUFACTURING CORPORATION • 3200 UNION ST., MISHAWAKA, INDIANA

New Bearing by Dodge—

Spher-Align

ANNOUNCING AMERICA'S NEWEST SPHERICAL ROLLER BEARING PILLOW BLOCK ...A RUGGED BEARING IN ATTRACTIVE MODERN DESIGN...INHERENTLY SELF-ALIGNING...EASY TO INSTALL...EASY TO MAINTAIN...AND FEATURING THE UNIQUE MICRO-MOUNT ADAPTER

AMERICA'S MOST COMPLETE LINE OF MOUNTED BEARINGS

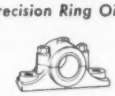
DODGE-TIMKEN
Tapered Roller

SPHER-ALIGN
Spherical Roller

SC, SCM, SL
Ball

SLEEVOIL
Precision Ring Oiling

BRONZOIL
Capillary Oiling



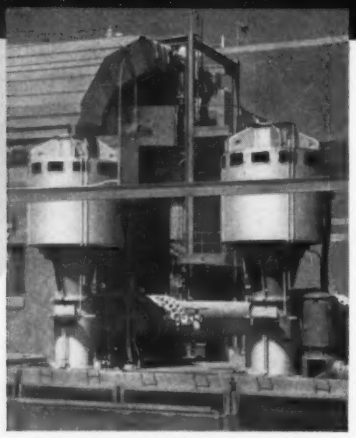
BABBITTED
Solid and Split

PILLOW BLOCKS • HANGER BEARINGS
FLANGE BEARINGS • UNIT MOUNTS • TAKE-UPS

DODGE
of Mishawaka, Ind.

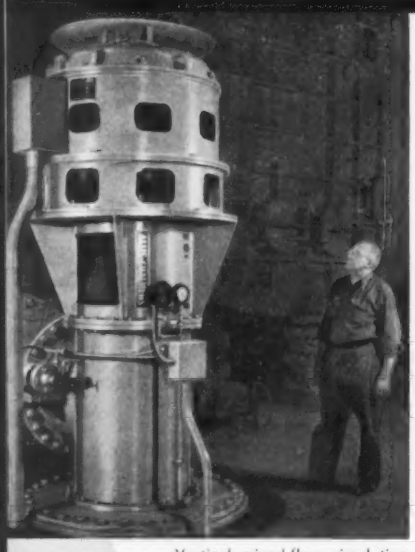
CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in the yellow pages of your telephone directory — or write us.

condensing equipment...

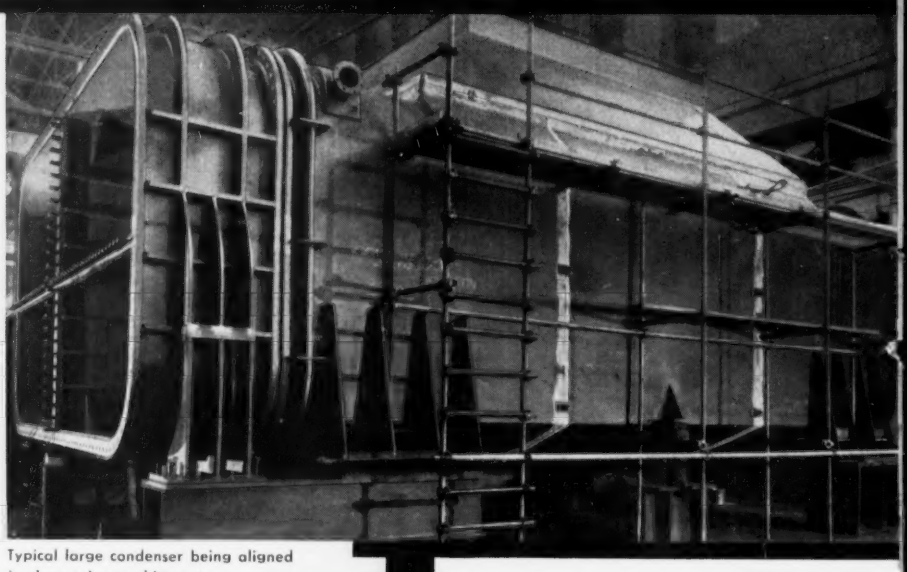


Tube-type Allis-Chalmers motors driving condenser cooling water pump.

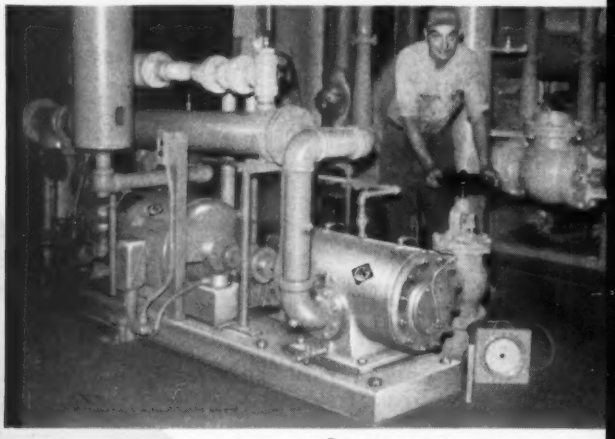
Get the whole



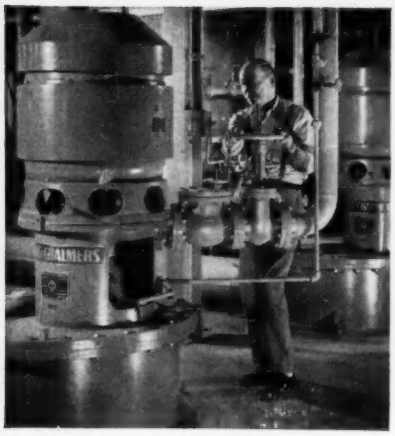
Vertical mixed-flow circulating water pump and motor.



Typical large condenser being aligned in shop prior to shipment.



Two-stage rotary vacuum pump.

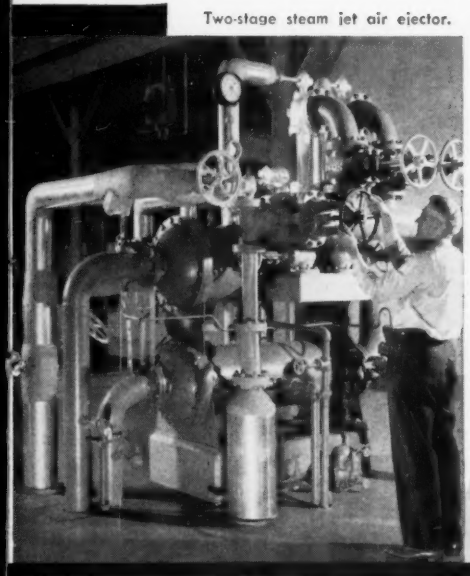


Condensate pumps and motors.

"ball of wax"

from Allis-Chalmers

Two-stage steam jet air ejector.



You get all that "unit responsibility" implies in coordination of original engineering, ordering, and installation with Allis-Chalmers condensing equipment.

For A-C builds the condenser with its auxiliary apparatus, including pumps, motors, air removal equipment, switchgear, etc. Moreover, the experience in building millions of square feet of condensers of every size, shape and type enables Allis-Chalmers to meet your special conditions with a high efficiency, high vacuum installation.

for information about Allis-Chalmers condensing equipment, call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-5355

it's **boiler check-up** time!

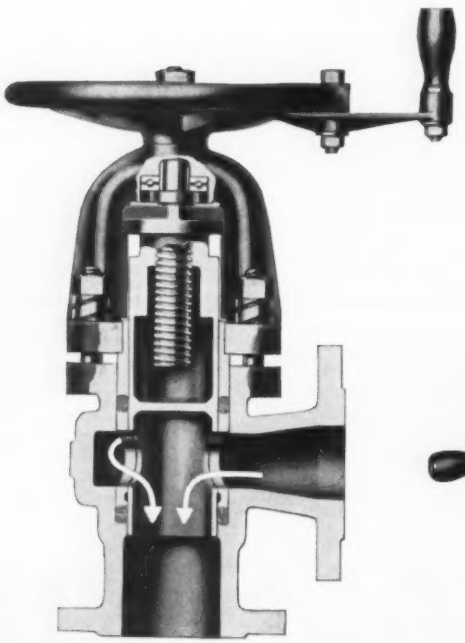
✓ HOW ARE YOUR BLOW-OFF VALVES?

Are they drop-tight? Rugged and dependable? Easy to maintain?

Just as important, do they have all the advantages and up-to-date improvements in materials and design of new YARWAY Blow-Off Valves?

Old YARWAY Blow-Off Valves also can be overhauled and modernized, because all YARWAY improvements are *interchangeable* with parts on earlier models.

Write today for YARWAY Blow-Off Valve CHECK SHEET—also new YARWAY Blow-Off Valve Catalog B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).



Yarway Seatless valve for low and medium pressures. Features balanced nitralloy plunger that seals line drop tight—yet permits free, unobstructed flow in blow-down. **Used in over 15,000 boiler plants.**

Yarway Unit Tandem Blow-Off Valve for higher pressures. Combines Yarway Seatless Valve and Yarway Hard-Seat Valve, or two Yarway Hard Seat Valves, in a one-piece forged steel body. For years—the choice of 4 out of 5 high pressure power plants.

YARWAY steam

✓WHAT ABOUT WATER COLUMNS AND GAGES?

Are they in good working order? Are they up-to-date?

If your boiler pressures are over 900 psi, have you considered the advantages of the new YARWAY COLOR-PORT Gage? It offers brilliant two-color (red and green) readings, greatly reduced maintenance, increased availability and longer service life.

Write for full details in Bulletin WG-1814

✓HOW ABOUT ADDING NEW REMOTE LEVEL INDICATORS?

Remote readings of boiler water level at any spot in the plant are a recognized convenience —and easy with "Wide Vision" YARWAY Remote Liquid Level Indicators.

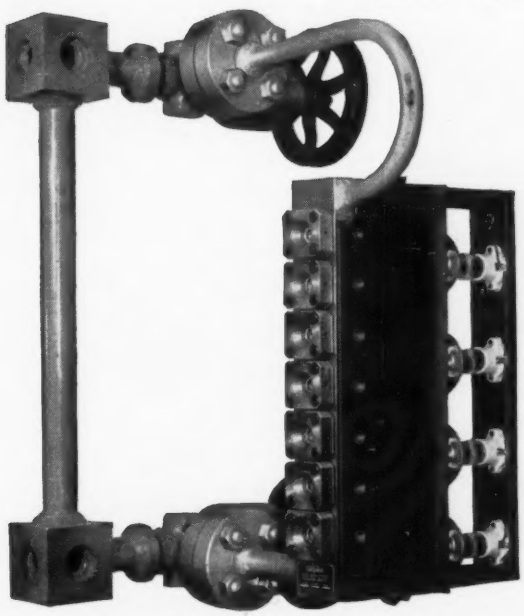
Because the indicating mechanism is operated by the boiler water itself, response is always instant, readings always accurate.

YARWAY Hi-Lo Graph Recorder not only gives remote indication but also a 24-hour recording of water levels.

YARWAY Remote Indicators and Recorders can also be supplemented with Remote Hi-Lo Alarm Signals—light or horn.

Write for Catalog WG-1824.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



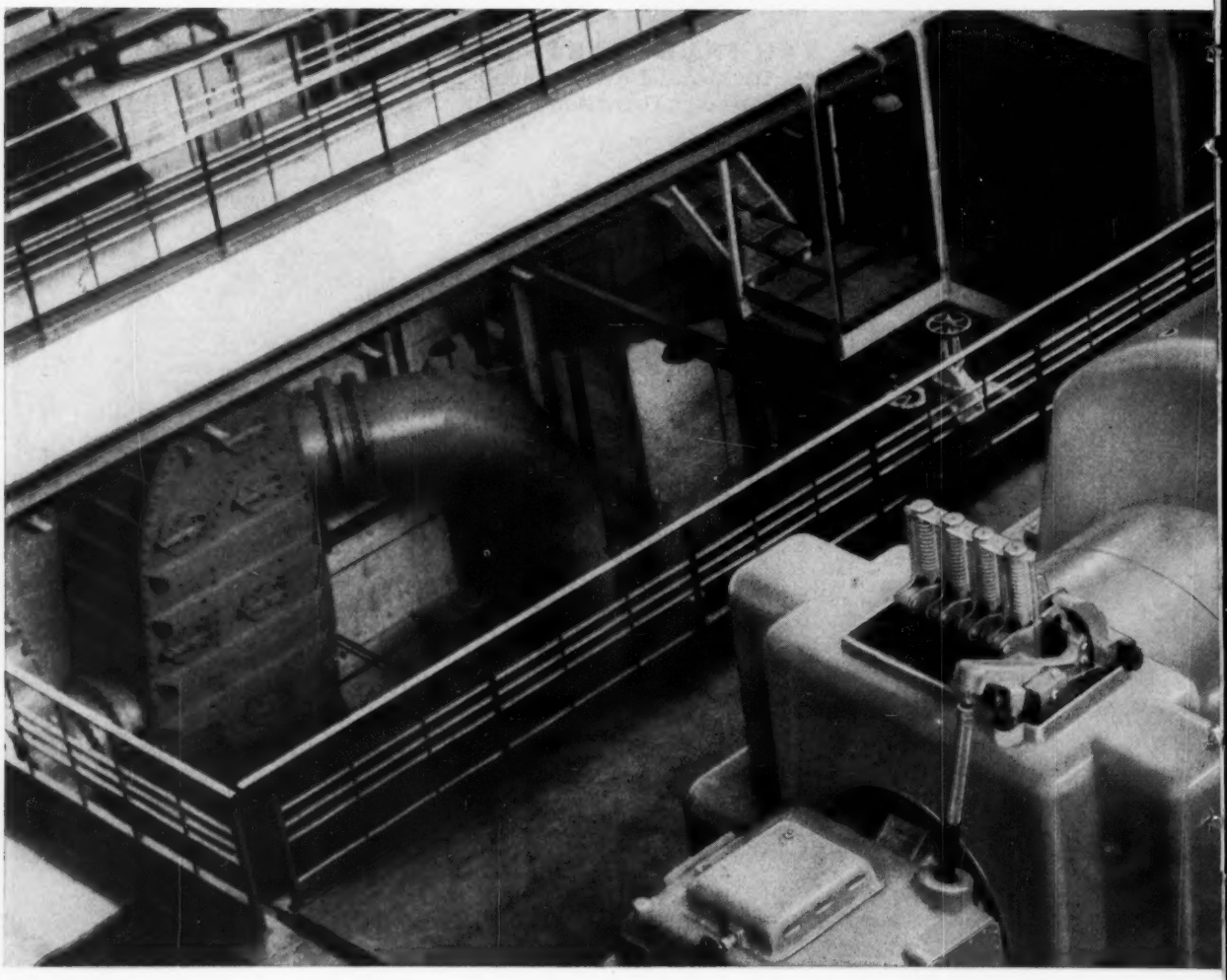
Side view of new Yarway Color-Port Water Level Gage with illuminator, circulating tie-bar and Welbond gage valves. Water space shows green in the gage; steam space shows red.

Yarway Remote Liquid Level Indicator with "wide vision" face. Manometric type with automatic temperature compensation where required. Over 10,000 used throughout industry.

plant equipment

Why more leading utilities depend on GULFCREST than on any other turbine lubricant

Georgia Power Company's Yates Plant has three 100,000 kw turbines working—protected by Gulfcrest. They'll soon add a fourth unit, a 125,000 kw turbine . . . and it will be filled with Gulfcrest, too. Each system holds 3,450 gallons of Gulfcrest, finest turbine oil available today!



In Gulf's marketing area, more power is generated by central station steam turbines filled with Gulfcrest than by units using any other lubricant.

Gulfcrest has an outstanding record for protection over the years. In many large turbines Gulfcrest has served continuously for 15 to 20 years with neutralization numbers low, systems free from sludge and rust.

The list of Gulfcrest users reads like a "who's who" of prominent utilities. To find out more about this superb, non-foaming, oxidation-resisting turbine oil ask a Gulf Sales Engineer. Call your nearest Gulf office, or write us for new, illustrated Gulfcrest bulletin, just off the press.

NINE DIFFERENT STEPS, INCLUDING GULF'S EXCLUSIVE ALCHLOR PROCESS, TO PRODUCE GULFCREST!

Gulf, as one of the largest crude oil producers, can select the finest crudes as base oil.

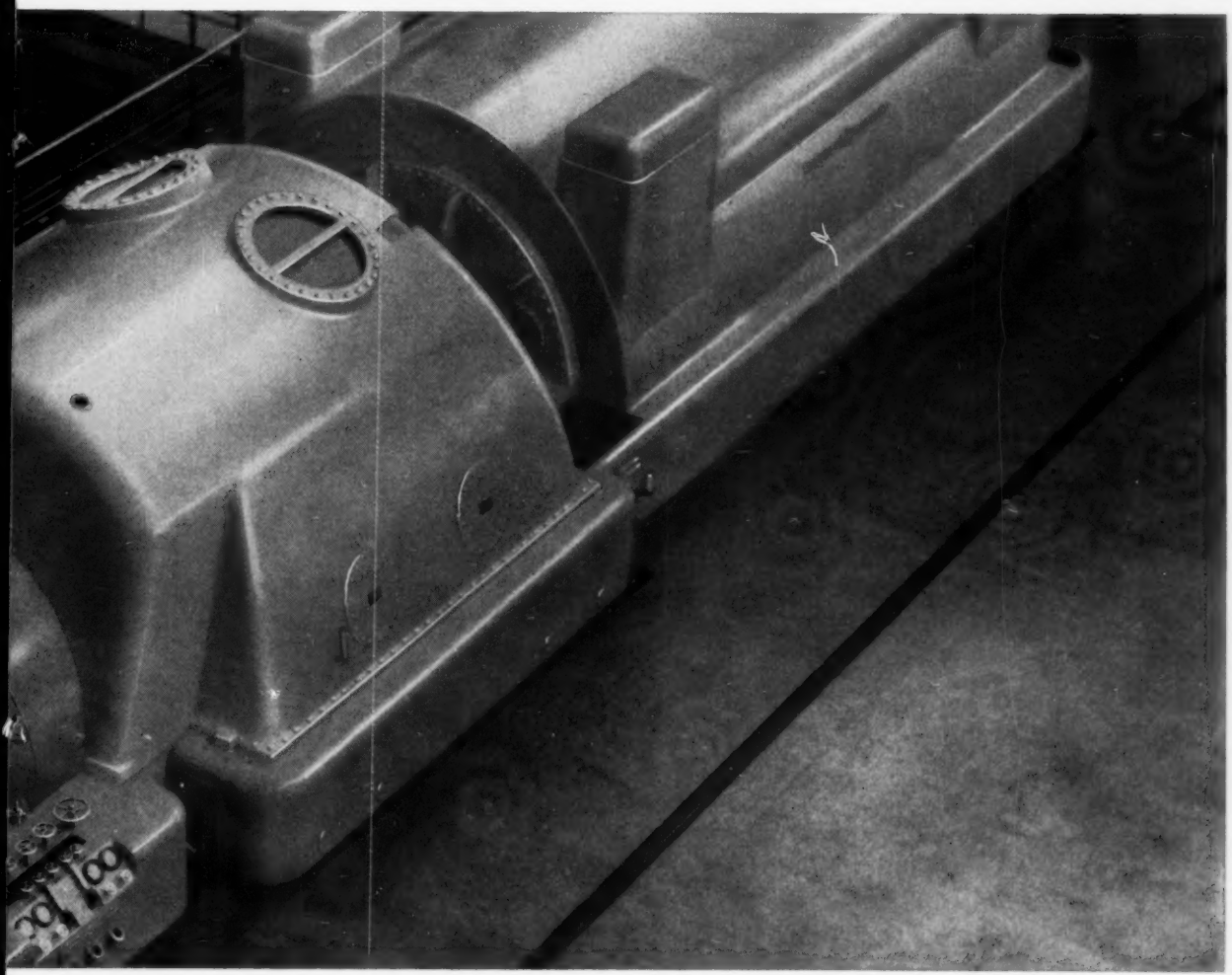
The base oil is first distilled, then put through propane de-asphalting, refined with phenol, de-waxed, fractionated, *super-refined by the Alchlor Process,* processed by clay contacting and filtered.

Only then is it ready for proper additives . . . and Gulf leads in the development of more effective turbine oil additives!

GULF OIL CORPORATION
1822 Gulf Building
Pittsburgh 30, Pa.

GULF

THE FINEST PETROLEUM PRODUCTS FOR ALL YOUR NEEDS

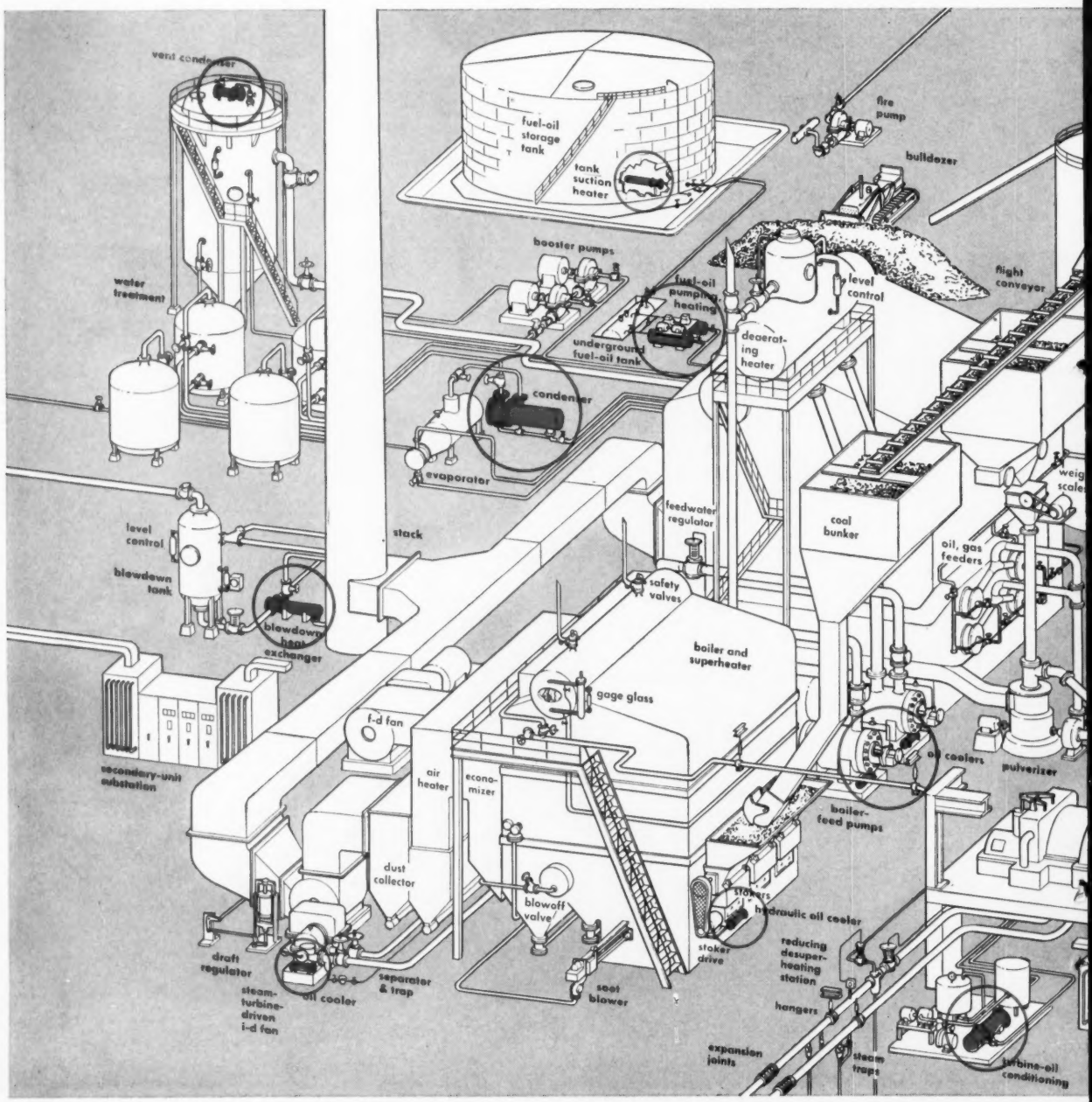


Ross Exchangers and Condensers perform

This layout of a modern steam power plant could be yours today or a blue print of your future one. It could be a central station or an industrial plant. The interrelated equipment could represent all of your needs, part of your needs or more than you need.

From the standpoint of heat exchange and condensing equipment, however, this one fact stands out firmly: Regardless of the function and the condition, there's a Ross Exchanger and Condenser to meet *every* power plant requirement. See for yourself. Surface Condenser? It's there. Feedwater Heater? It's there. Blowdown Exchanger? It's there. Fuel Oil Heater? It's there. Now look over the machines and other equipment that require oil cooling — the Diesels, air compressors, turbines, transformers, boiler feed pumps. There's a Ross Exchanger to serve every one of them. The compressor cylinder-mounted intercoolers, the hydraulic oil coolers for the stoker drive, the jacket water coolers for both engines and compressors, the tank suction heaters . . . on it goes from one end of the plant to the other.

Where does the list end? It doesn't with Ross.



numerous services in the modern steam power plant

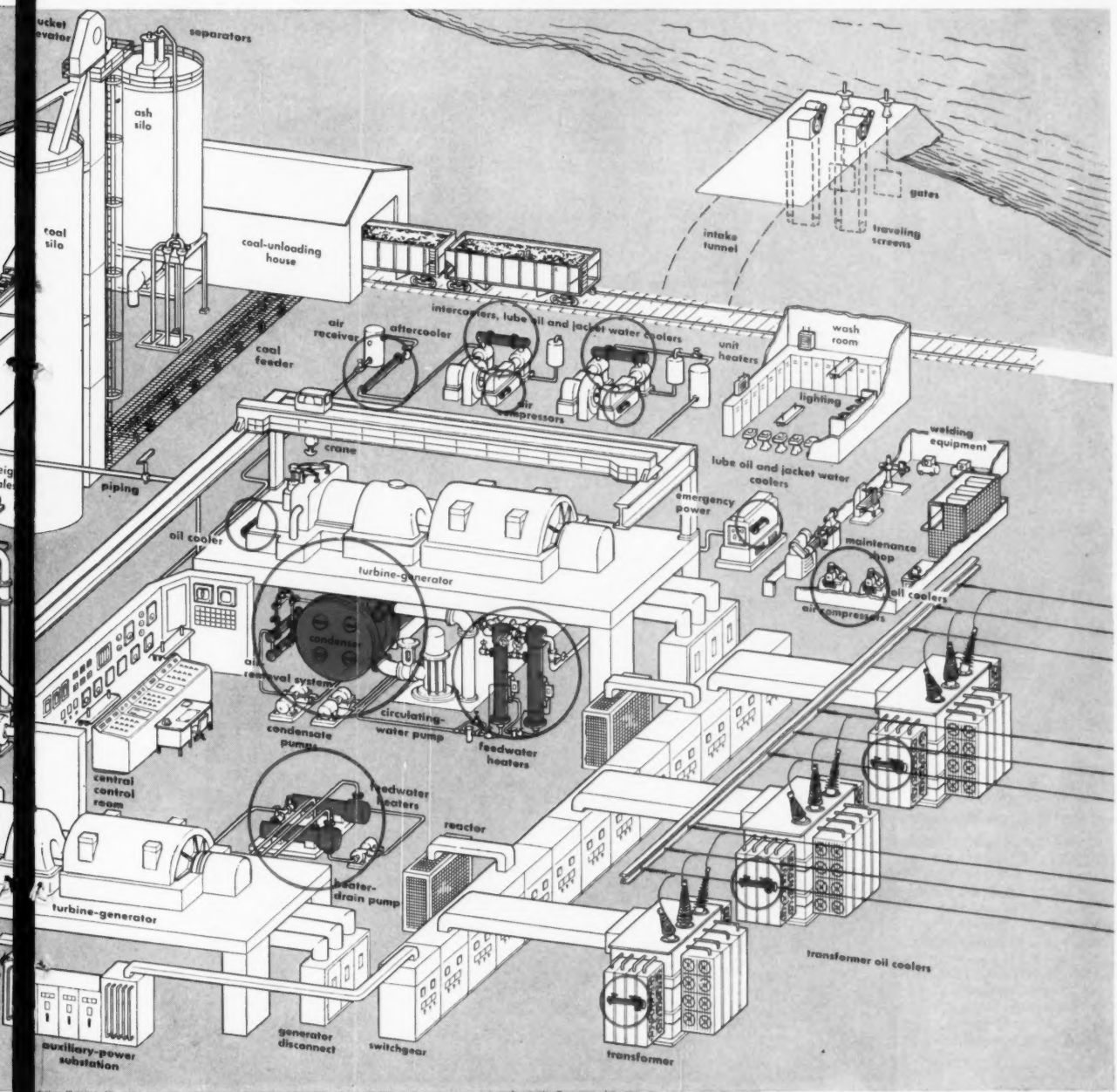
Standard or special, primary equipment or machine components, large or small, one of a kind or dozens alike, Ross Exchangers and Condensers are designed and built for optimum performance in every type of service within the modern steam power plant.

And of this you can be sure: A Ross engineer, in consultation with yours, not only has the most to offer in the way of equipment, but the most in experience, too. The name Ross is renowned in the power generation field — utilities, industries, institutions, major buildings, engineering and contracting firms throughout the world.

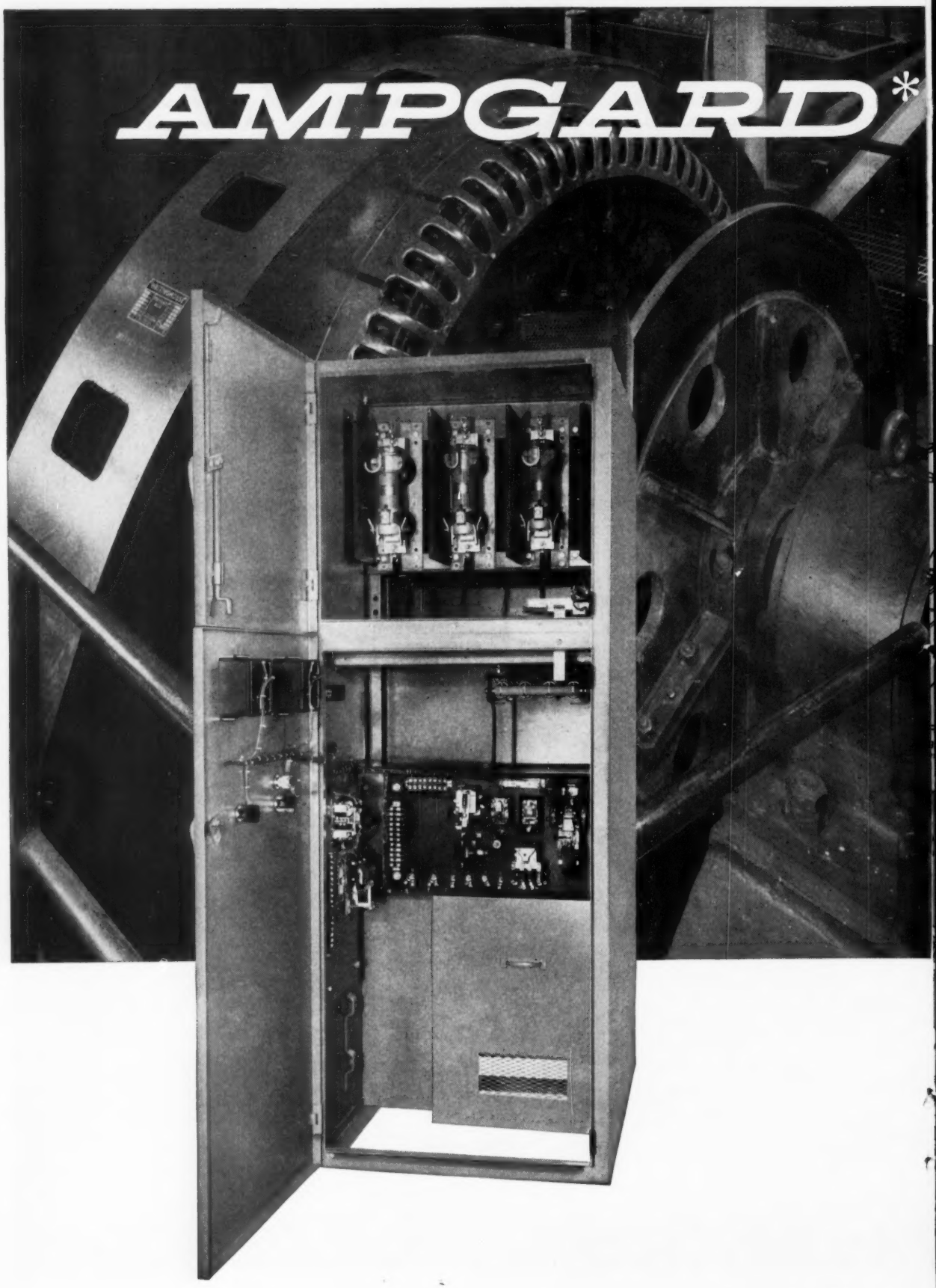
Complete literature on specific products will be mailed promptly at your request. Write: Ross Heat Exchanger Division of American-Standard, Buffalo 5, N. Y. In Canada: American-Standard Products (Canada) Limited, Toronto 5, Ont.

ROSS HEAT EXCHANGER

Division of **AMERICAN-Standard**



DRAWING COURTESY POWER MAGAZINE


AMPGARD*

automatic synchronizing assures top motor performance

Westinghouse high-voltage synchronous motor starters with . . .

Automatic Synchronizing . . . assures a good start every time. Maximum synchronizing torque results from applying the field excitation at the most favorable rotor position. Starting time is the shortest possible, because the motor is synchronized as soon as it accelerates to pull-in speed.

Motor Protection . . . separate relays protect stator against sustained overloads and also protect rotor damper windings against failure of the motor to start. Motor is automatically stopped if it pulls out of step.

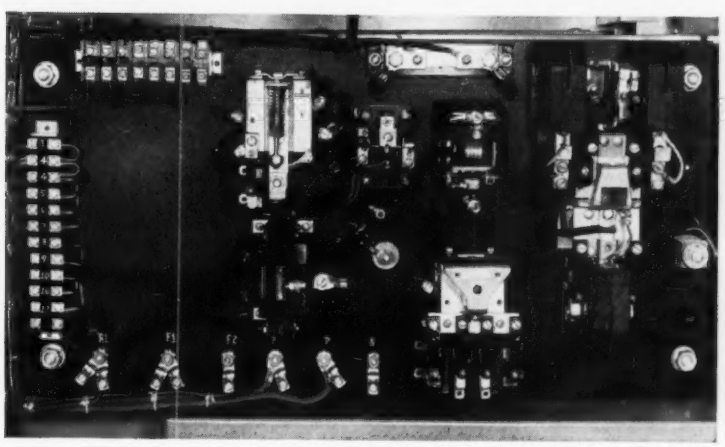
Complete Circuit Protection . . . assured for high-voltage starting by Westinghouse type BAL fuses that safely interrupt fault currents on systems up to 250,000 kva. This is the kind of protection your plant system needs with the ever-increasing voltages being supplied today.

For complete information about AMPGARD, the most complete line of high-voltage starters available to industry, call your local Westinghouse sales engineer or write Westinghouse Electric Corporation, P.O. Box 868, 3 Gateway Center, Pittsburgh 30, Pa.

*Trade-Mark

J-22025

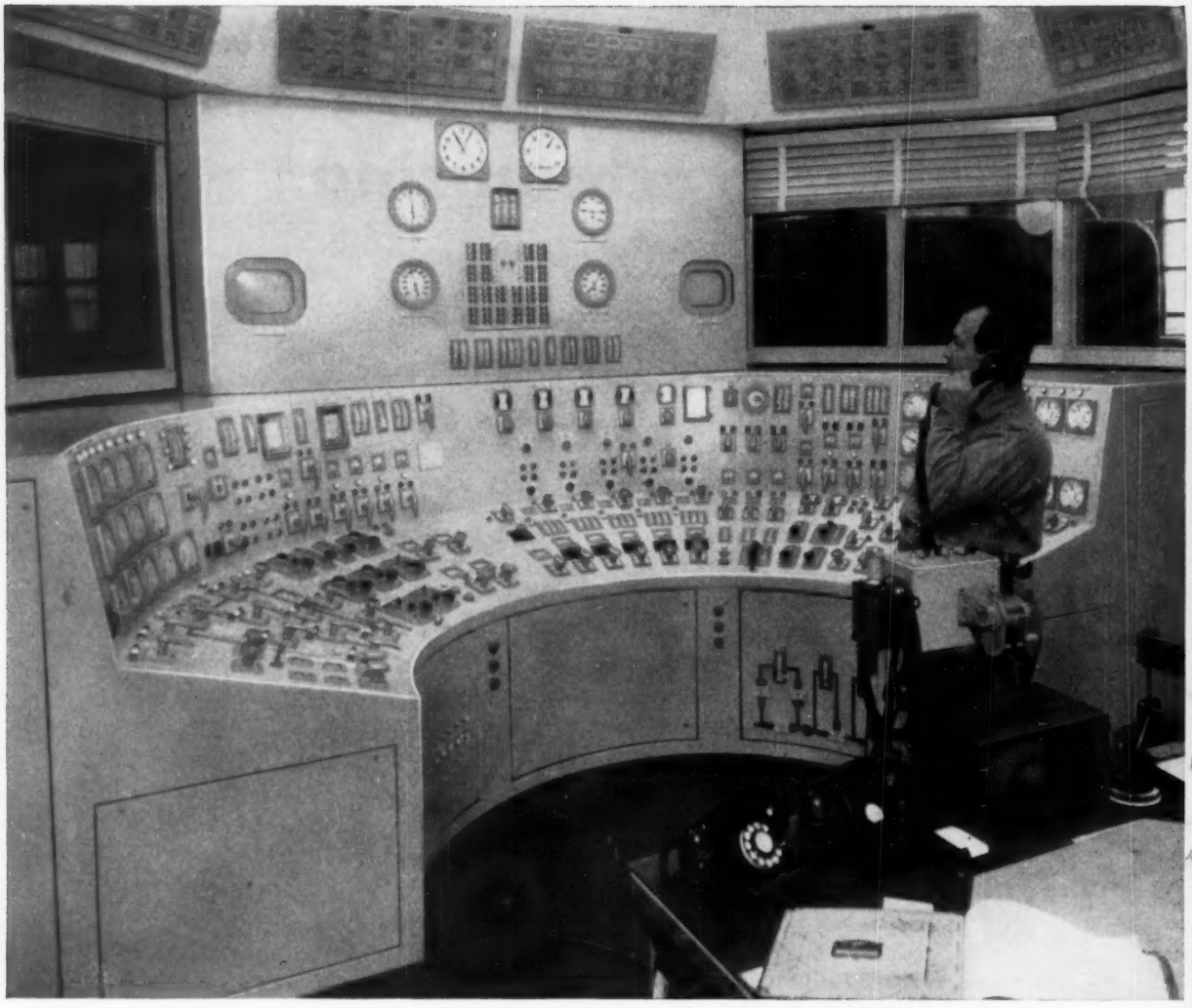
YOU CAN BE SURE...IF IT'S Westinghouse



SLIPSYN® PANEL
the heart of Westinghouse Synchronous Motor Starters

This panel, with the exclusive Westinghouse ASR relay, controls automatic synchronizing on start-up, protects motor windings, shuts down motor in the event of loss of synchronization and protects damper windings if the motor fails to start. Westinghouse synchronous starters with SLIPSYN panels guarantee a good start every time.

*Registered Trade-Mark



Advanced central control uses L&N combustion system to

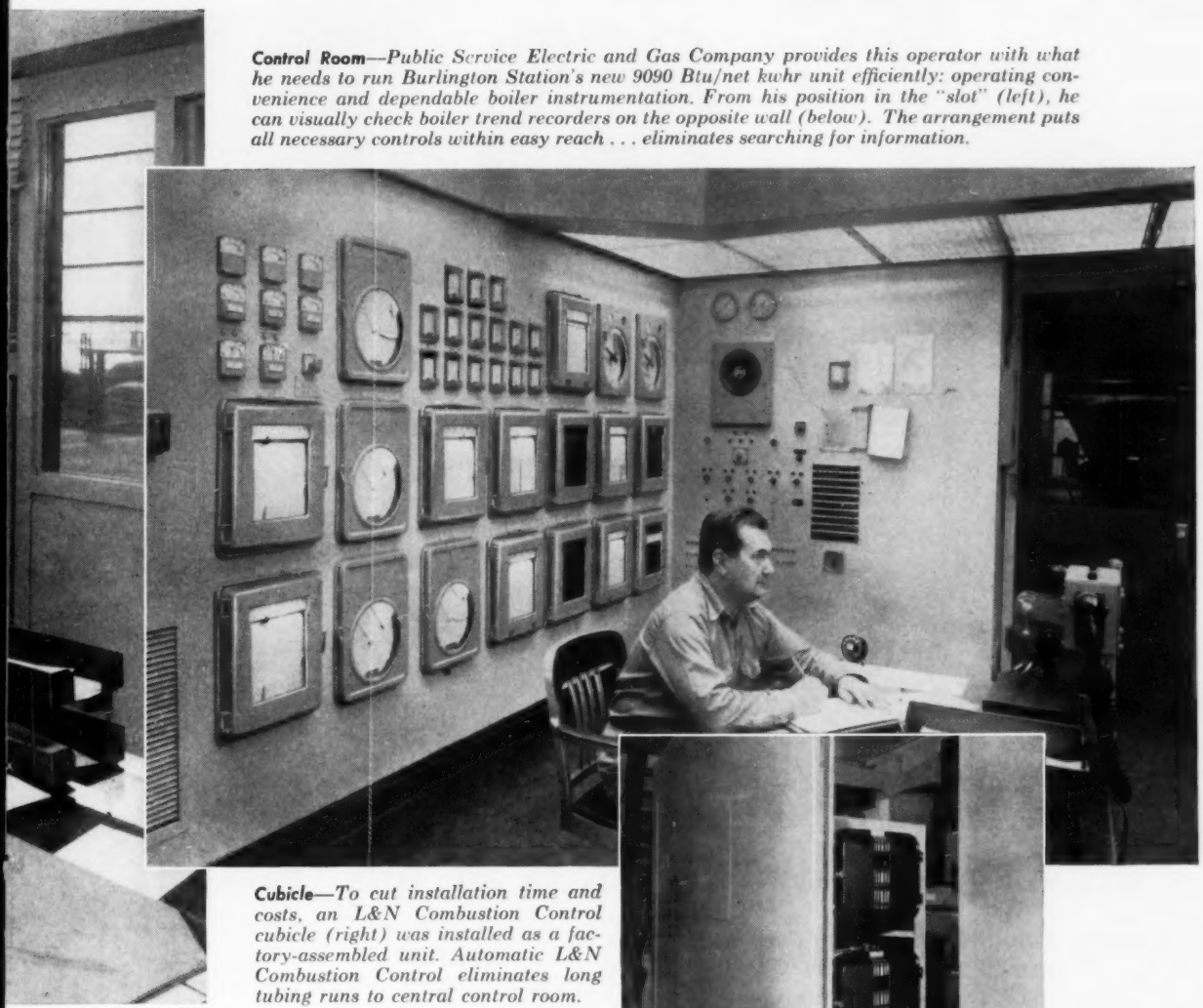
• In this Burlington, New Jersey plant of the Public Service Electric and Gas Company, the newly completed No. 7 Unit's heat rate for the first six months of commercial service was 9090 Btu/net kwhr, the best in the country. Number Seven's boiler capacity is 1,225,000 lb/hr, with turbine throttle steam pressure of 2350 psi, superheat and reheat temperatures of 1100 F and 1050 F, and generator output of 200,000 kilowatts. Furnace fuel is either coal or oil.

A quick glance at Burlington's central control room for this unit is all that's needed to realize that Public Service's advanced engineering techniques went into it. For example, the control room operator has control information brought to *him*. Due to the compact console arrangement he can perform his duties as conveniently and effectively as an airline pilot. There's no wasted space, time or effort.

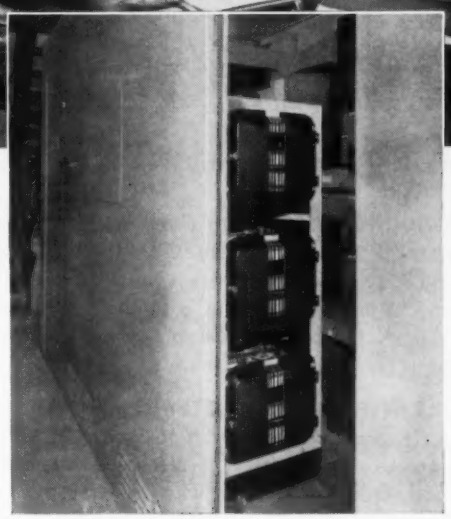
A desirable arrangement—but how is it accomplished without sacrificing reliability, accessibility or economy of components?

A major part of the answer is use of standard Leeds & Northrup *electric* control switches and position indicators. In addition, an auxiliary control cubicle houses the control auxiliaries . . . saves installation time and costs. Made at the L&N factory, it's delivered ready for operation, minimizing those inevitable last-minute installation problems.

Another "problem solver" is L&N combustion control which day after day provides precise steam pressure and excess air regulation—enables the new unit to perform at high efficiency. One reason is that this is a basically electric control—electric drive units introduce no transmission lags regardless of control room location . . . and *no* weather can freeze the electric transmission cables which



***Control Room**—Public Service Electric and Gas Company provides this operator with what he needs to run Burlington Station's new 9090 Btu/net kwhr unit efficiently: operating convenience and dependable boiler instrumentation. From his position in the "slot" (left), he can visually check boiler trend recorders on the opposite wall (below). The arrangement puts all necessary controls within easy reach . . . eliminates searching for information.*



***Cubicle**—To cut installation time and costs, an L&N Combustion Control cubicle (right) was installed as a factory-assembled unit. Automatic L&N Combustion Control eliminates long tubing runs to central control room.*

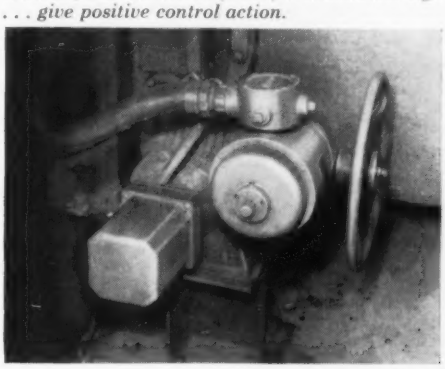
guide unit with best heat rate

connect to Burlington's outdoor electric L&N drive units.

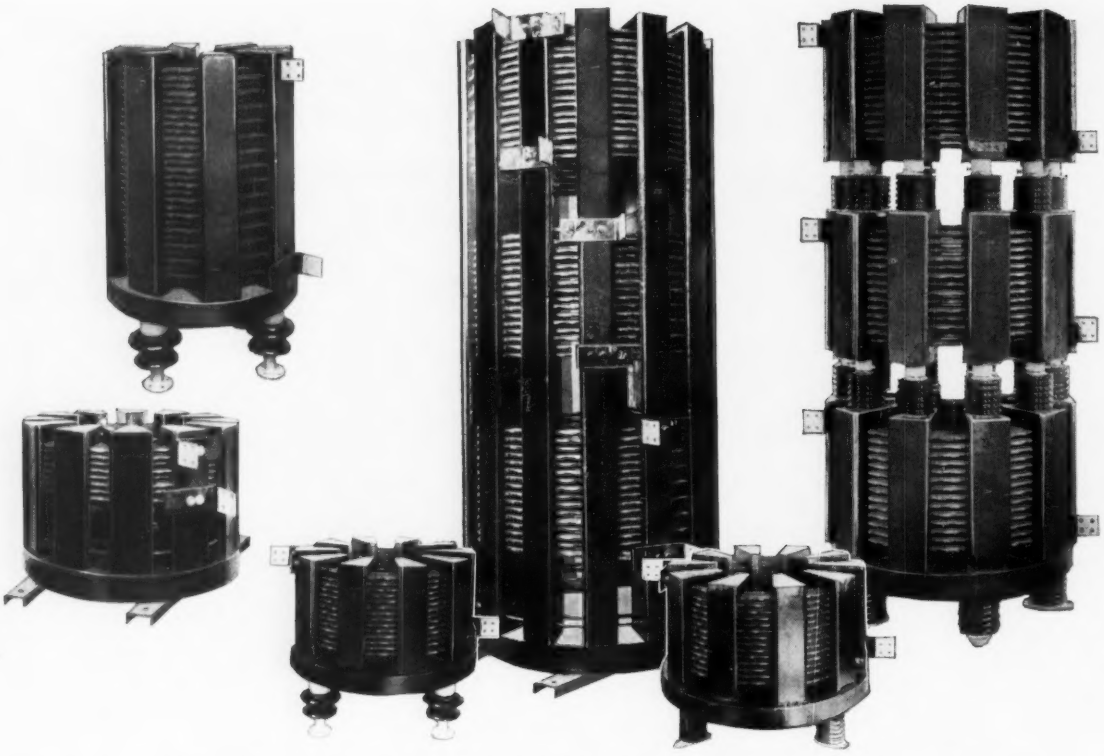
As you would expect, the new unit was placed on automatic control well within the first week's continuous operation of the unit. Significantly, the complete combustion and steam temperature control, as well as flue gas oxygen measurement for the new Public Service Linden Generating Station, is L&N.

We'd like to suggest that if you're looking toward a new unit which calls for integrated controls, you look to Leeds & Northrup Company, 4910 Stenton Avenue, Philadelphia 44, Pa.

LEEDS Instruments **NORTHRUP** Automatic Controls • Furnaces



***Drive Unit**—With rugged outdoor L&N electric drive units (below), the operator knows he's getting efficient operation. No matter what the weather, these units are free of transmission lags . . . give positive control action.*



General Electric offers 8% lower prices, faster delivery in 24 new ratings of RM* reactors

8% PRICE REDUCTION and two to three weeks shorter shipment, possible for years with G.E.'s Repetitive Manufacture (RM) reactors, are now available in 24 new ratings up to 2000 amperes in both the 4160- and 14,400-volt classes. This means major savings in your most-required protective ratings.

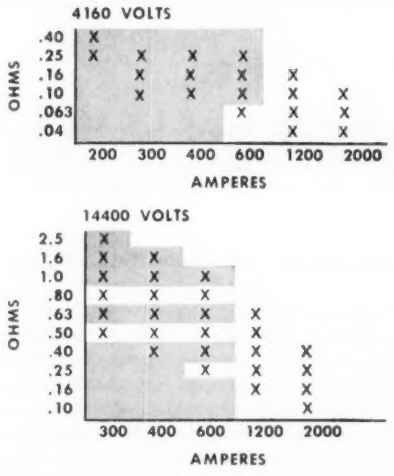
RM REACTORS HELP PROTECT COSTLY EQUIPMENT and reduce system expansion costs by helping limit short-circuit currents to the capacity of other components. For this reason, G.E.'s reactor ratings are designed to coincide with the standard short-circuit ratings of switchgear, regulators, and other system equipment.

OPPORTUNITIES FOR SAVINGS exist throughout your system. Feeder protection, bus sectionalizing, bus synchronizing, and neutral grounding are only a few of the applications where G.E.'s complete line of reactors can help reduce equipment investment. Full details are available from your G-E Sales Engineer or from Section 422-38, General Electric Co., Schenectady 5, N. Y.

*Repetitive Manufacture

COMPLETE RM* REACTOR LINE

(Unshaded areas indicate new ratings)



Progress Is Our Most Important Product

GENERAL ELECTRIC

Seamless fittings for A-power reactors.
TUBE-TURN* 100° elbows—heavy wall thickness—stainless steel

Planning nuclear reactor piping?

TUBE TURNS CAN HELP YOU!

Since the origin of atomic energy projects, Tube Turns has been recognized as the leader in welding fittings for this fast-moving industry. Working with reactor builders, Tube Turns is now applying advanced techniques to the manufacture of seamless, forged fittings—in stainless steels, stainless-clad carbon steel, chrome-moly steels, aluminum and titanium.

Made to close tolerances and exacting specifications, these TUBE-TURN products are playing a vital part in industrial and government A-power projects.

For Tube Turns' engineering service on nuclear energy piping projects, call our nearest office.

The Leading Manufacturer of Welding Fittings and Flanges

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*"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.

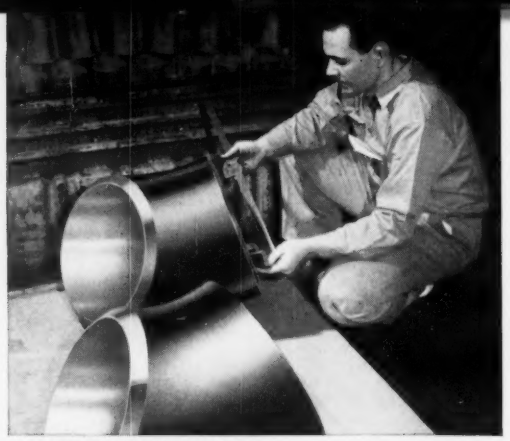
MORE INFORMATION...

In the nuclear energy field...

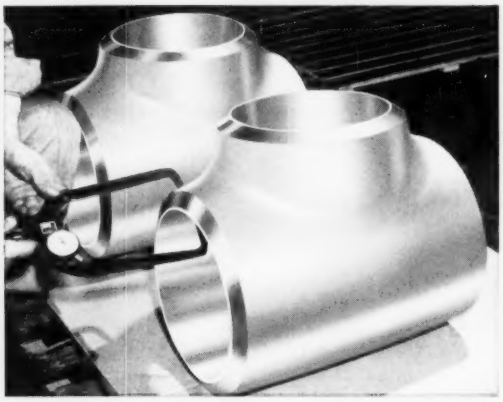
as in all fields...

YOU GET TOP QUALITY

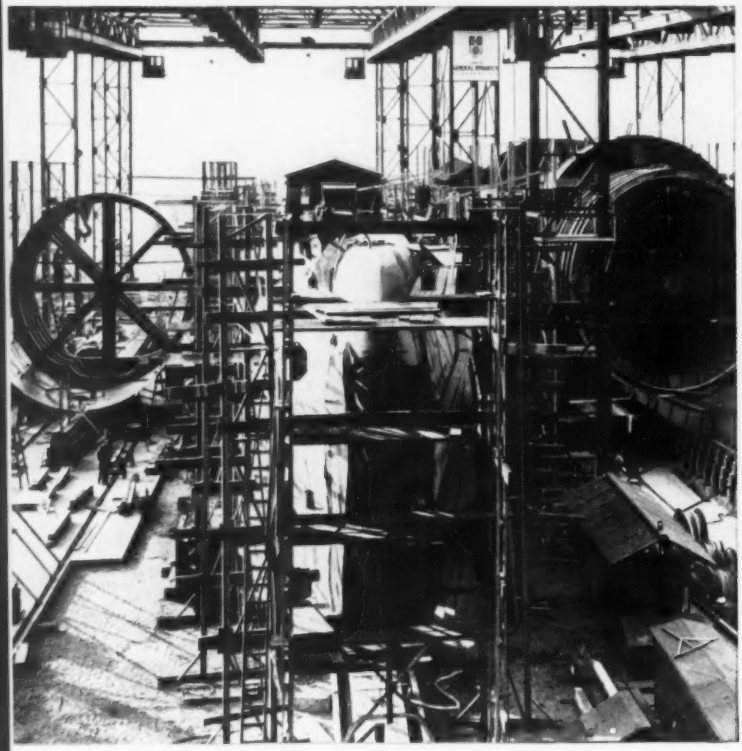
from TUBE TURNS!



SEAMLESS STAINLESS CLAD . . . another Tube Turns' first. These heavy-wall 52° elbows for a pressurized water reactor are typical of Tube Turns' pioneering line of seamless stainless-clad carbon steel fittings.



STAINLESS STEEL. These TUBE-TURN stainless steel welding tees are for a two-reactor submarine.



FASTEST AND LARGEST. TUBE-TURN* Welding Fittings will be used for coolant piping of the "Skipjack" (on left), and for all main coolant piping of two-reactor sub "Triton" (on right), the largest sub. These nuclear-powered submarines are shown on the ways at Electric Boat Division, General Dynamics Corp., Groton, Connecticut.

ALUMINUM. These TUBE-TURN Aluminum Elbows are for nuclear swimming pool reactor water-coolant lines. Unsurpassed uniformity of wall thickness, circularity and curvature.

For consultation on nuclear power piping problems, call the nearest Tube Turns' office.

*"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.

MAIL COUPON FOR INFORMATION

TUBE TURNS, Dept. C-3
224 East Broadway, Louisville 1, Kentucky

I have a reactor piping problem involving welding fitting and flange material checked. Please send information.

☐ Stainless-clad steel	☐ Copper	☐ Hastelloy
☐ Stainless steel	☐ Titanium	☐ Zirconium
☐ Aluminum	☐ Nickel alloys	☐ Chrome-moly steel

Company _____

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Your Name _____

Position _____

TUBE TURNS

LOUISVILLE 1, KENTUCKY
A DIVISION OF NATIONAL CYLINDER GAS COMPANY

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new pressure switch

. . . has the appearance and performance you need

Looking for something new, something better, to control or limit the pressure of air, gas, oil? Use this new Honeywell Industrial Pressure Switch . . . designed to complement the most attractive equipment or panels . . . constructed to give lasting performance in the most rugged applications. Use it to make your equipment more automatic, improve your system, provide trouble-free service.

Here are the facts you'll want to know:

- Designed for flush or surface mounting
- Die-cast case is dust and corrosion resistant
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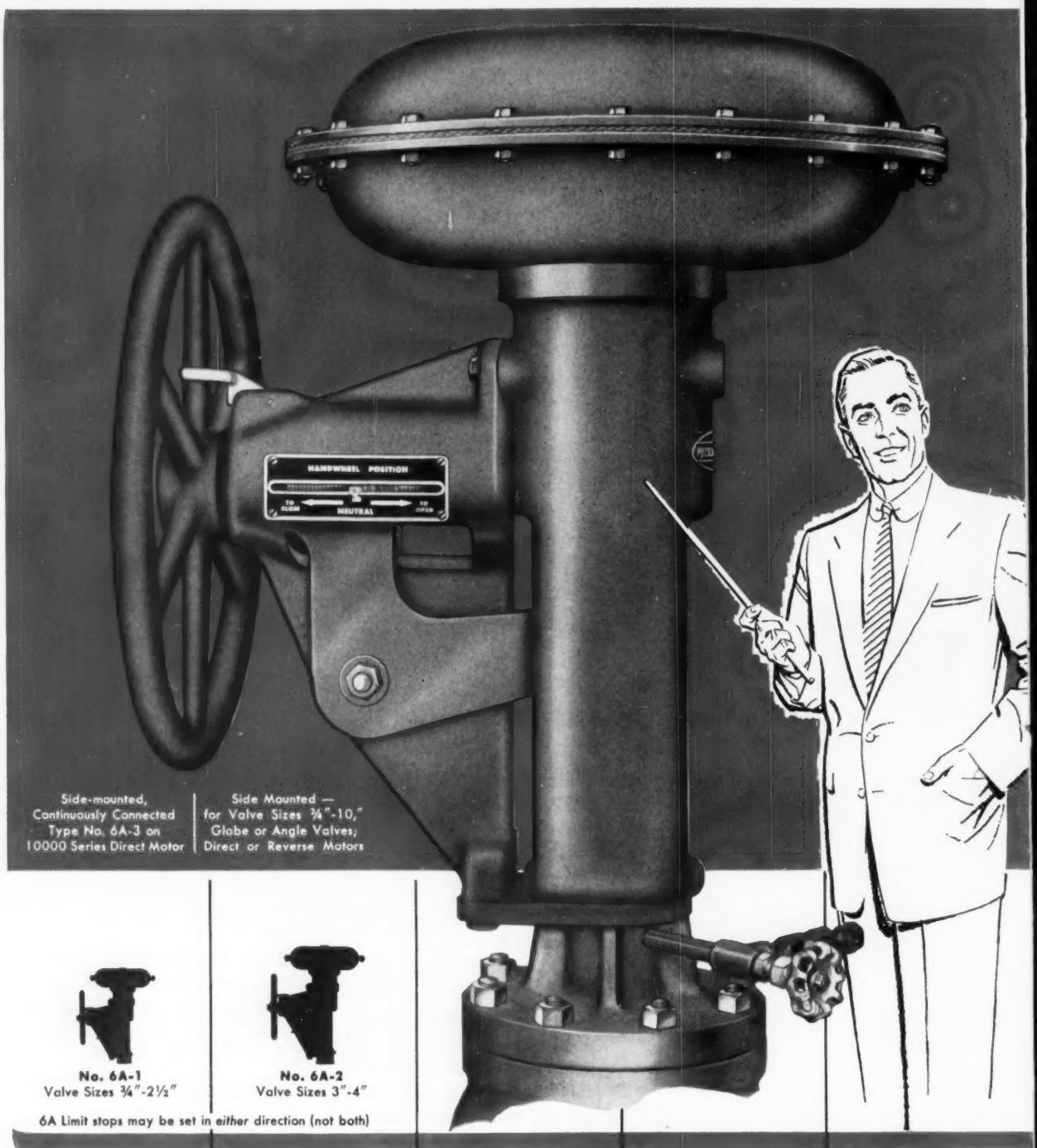
For complete data, a consultation on applications, prices for any quantity . . . get in touch with your local Honeywell sales engineer. He's as near as your phone. MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

● **REFERENCE DATA:** Write for Specification sheet S1011-3 "New Honeywell Industrial Pressuretrol"

MINNEAPOLIS **Honeywell**
BROWN INSTRUMENTS
First in Controls



Side-mounted, Continuously Connected Type No. 6A-3 on 10000 Series Direct Motor

Side Mounted — for Valve Sizes ¾"-10," Globe or Angle Valves; Direct or Reverse Motors

No. 6A-1
Valve Sizes ¾"-2½"

No. 6A-2
Valve Sizes 3"-4"

6A Limit stops may be set in *either* direction (not both)

No. 2-9
Valve Sizes ½"-1½"
Direct Motor

No. 2-11
Valve Sizes 2"-2½"
Direct Motor

No. 2-13
Valve Sizes 3"-4"
Direct Motor

No. 3-15
Valve Size 6"
Direct Motor

No. 3-18
Valve Sizes 8"-10"
Direct Motor

Case Mounted — for Valve Sizes ½"-16", All Valve Types • Limit stops may be set in one direction only (upward travel)

Masoneilan Handwheels Available in 17 Models for Extra Safety

For Emergency Manual Operation . . . For Travel Limit Stops on Air Operated Control Valves

Handwheels provide vital safeguards wherever air failure might be costly in loss of process media or dangerous to plant and personnel. In these cases, provision for manual operation of the control valve is inexpensive insurance.

Mason-Neilan offers the widest available selection of handwheel equipped control valves to provide this extra measure of safety for such applications as . . .

- **Liquid or gas pipe lines**
- **Feed lines to process heaters**
- **Main process backpressure service, such as poly plant reactor outlets**
- **Critical liquid level control installations, especially ammonia let-down**

In addition, these handwheel units are equally useful in providing travel limit stops to insure . . .

- **Limiting minimum flow on gas fired units**
- **Limiting maximum flow on liquid level applications and similar installations**

The Masoneilan Handwheel is sturdily constructed and matched to the individual control valve to do the job for which it is designed, with a minimum of effort. For further information consult the office nearest you — or write . . .

MASON-NEILAN
Division of Worthington Corporation
33 NAHATAN STREET, NORWOOD, MASSACHUSETTS

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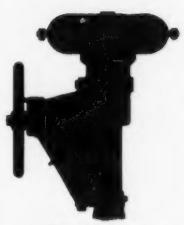
Sales Offices or Distributors in the Following Cities: New York • Syracuse Chicago • St. Louis • Tulsa • Philadelphia • Houston • Pittsburgh Atlanta • Cleveland • Cincinnati • Kansas City • Phoenix • Detroit San Francisco • Louisville • Salt Lake City • El Paso • Albuquerque Charlotte • Los Angeles • Corpus Christi • Denver • Appleton Birmingham • New Orleans • Seattle
Mason-Neilan Regulator Co., Ltd., Montreal and Toronto



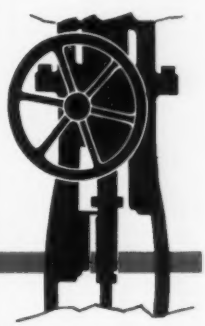
No. 6A-3
Valve Sizes 6″-10″
6A Limit stops may be set in *either* direction (not both)

No. 9-9
Valve Sizes ½″-1½″
Reverse Motor

No. 9-11
Valve Sizes 2″-2½″
Reverse Motor

No. 9-13
Valves Sizes 3″-4″
Reverse Motor

Limit stops may be set in *either* direction (not both)



Continuously Connected Gear Operated Type for Valve Sizes 12″-16″, Globe or Angle Valves; Direct or Reverse Motors
No. 8-18, 8-24

Limit stops may be set in *both* directions.

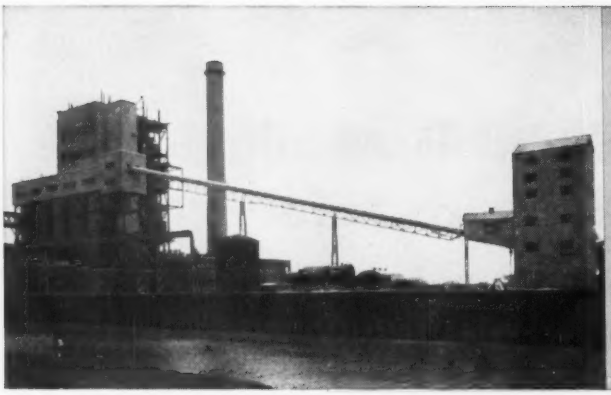
No. 4-18
Valve Sizes 8″-10″
Direct Motor

No. 5-18
Valve Sizes 12″-16″
Direct Motor

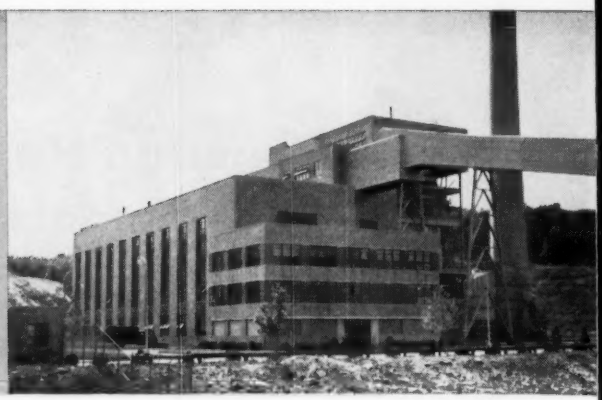
No. 6-18
Valve Sizes 12″-16″
Direct Motor

No. 7-24
Valve Sizes 12″-16″
Direct Motor

Case Mounted — for Valve Sizes ½″-16″, All Valve Type • Limit stops may be set in one direction only (upward travel)

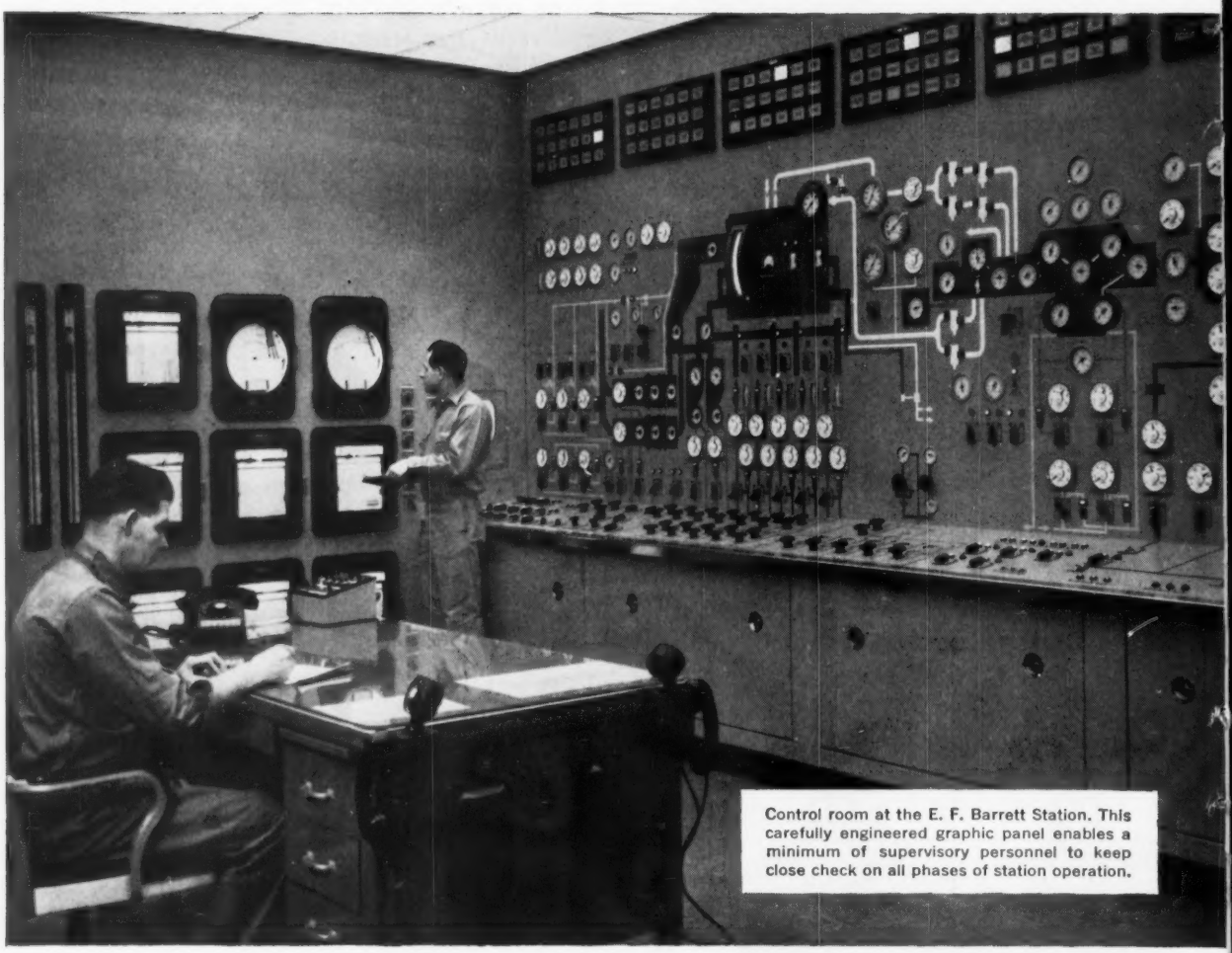


The E. F. Barrett Station, completed in 1956. This station has Hagan combustion control, three-element feedwater control, and primary metering. Designed to take full advantage of the latest construction techniques, a major part of the station is outdoors, following the pattern established at the Port Jefferson Station.

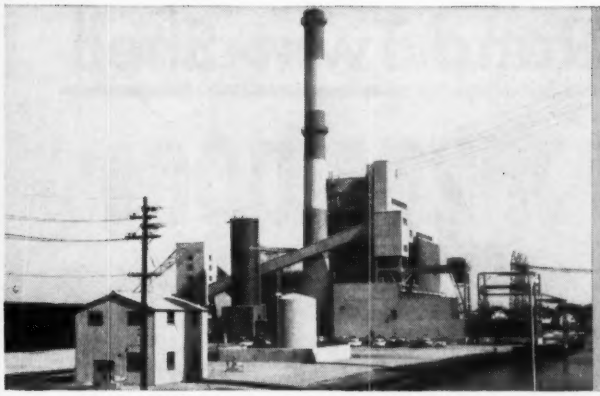


The Port Jefferson Station. Unit No. 1 (1949) has Hagan combustion control, as does Unit No. 2 (1950). Unit No. 3 will be equipped with Hagan Combustion Control, three-element feedwater control, and primary metering. The feedwater control system will include Hagan compensated drum level control.

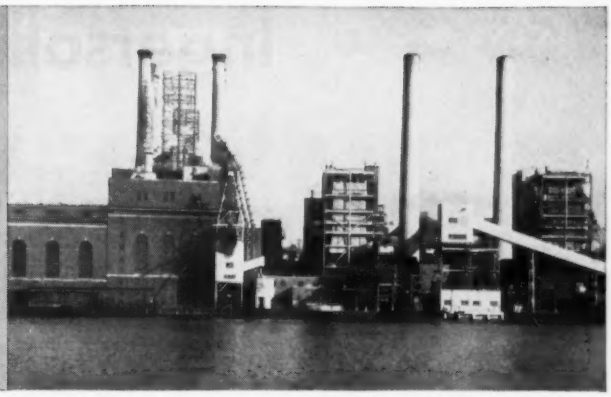
since 1942—Long Island



Control room at the E. F. Barrett Station. This carefully engineered graphic panel enables a minimum of supervisory personnel to keep close check on all phases of station operation.



Long Island Lighting Company's Station at Far Rockaway. This station went into commercial operation in 1954. It has a Hagan combustion control system. All of the stations, with the exception of Port Jefferson, are equipped with Hagan Remote Switching, providing a short direct signal path from controller to positioner.



Glenwood Station. Here Hagan has a long history. The first Hagan combustion control system was installed on Boiler #5 in 1942. Since then the record runs as follows: 1946—Boiler No. 6, 1952—Unit No. 4, 1954—Unit No. 5. Units No. 4 and No. 5 fire a combination of pulverized coal with oil or gas.

Lighting chooses HAGAN

Performance is the reason why Long Island Lighting Company now has Hagan combustion control systems on seven boilers, with an eighth on order. The last two of these are also equipped with Hagan three-element feedwater control. Management, engineers, and operating personnel alike have found that the simple, sturdy construction, high accuracy, and reliable operation of Hagan equipment contribute materially to station efficiency.

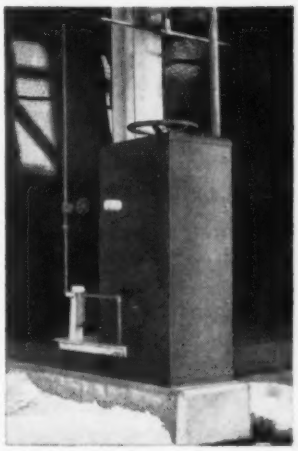
Hagan operating units perform well out-of-doors, and Hagan remote switching provides fast response to changing steam demands. Hagan three-element feedwater control includes drum level compensation which permits accurate indication and automatic control of drum level, even during start-up and shutdown.

Long Island Lighting Company is one of the nation's fastest growing utilities. The first installation of Hagan equipment was an automatic combustion control system for the #5 boiler at their Glenwood Station. On their newest unit, the very modern 180 Mw. E. F. Barrett Station, Hagan systems include automatic combustion control, three-element feedwater control, and metering.

Hagan's 39 years of experience in the design and manufacture of automatic controls for all types of boilers provide a unique background for the solution of control problems. A Hagan representative will be glad to discuss your requirements.

HAGAN CHEMICALS & CONTROLS, INC.

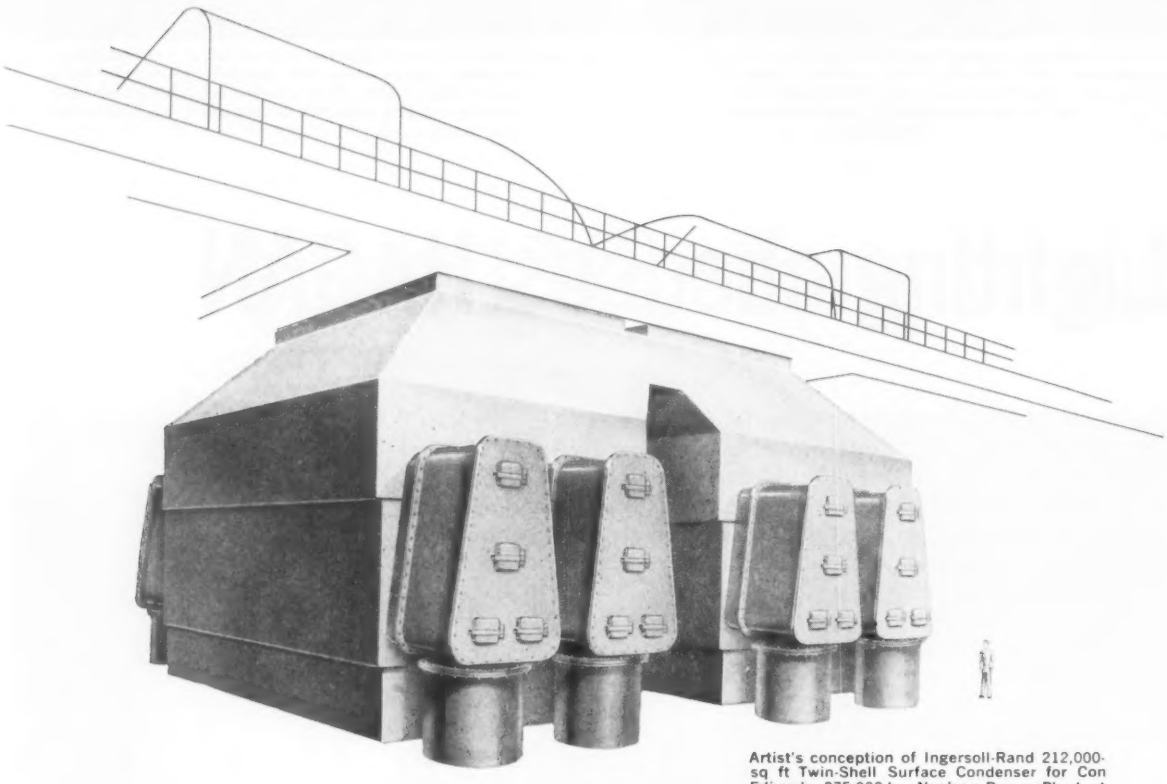
HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY • HALL LABORATORIES



Hagan Power Positioner for induced draft fan discharge dampers. The fully-enclosed Power Positioner is designed to provide accurate, reliable positioning, whether indoors or outdoors. Station operators are particularly pleased with the integral locking feature of the Hagan Power Positioner.

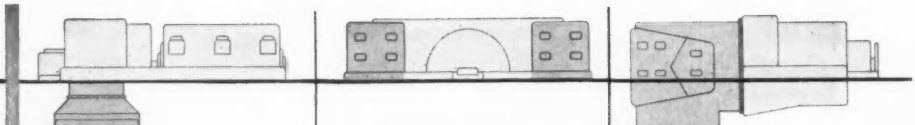
Ingersoll-Rand Twin-Shell

will serve Con Edison's 275,000-kw



Artist's conception of Ingersoll-Rand 212,000-sq ft Twin-Shell Surface Condenser for Con Edison's 275,000-kw Nuclear Power Plant at Indian Point

I-R Condensers set the pace in meeting all of today's turbine-condenser arrangements



BOTTOM EXHAUST: Regardless of headroom limitations, I-R surface condensers permit most effective utilization of all available under-turbine space. Sketch above, for example, shows a 65,000-sq ft condenser with headroom of only 14 ft 8 in, serving a 135,000-kw bottom-exhaust turbine.

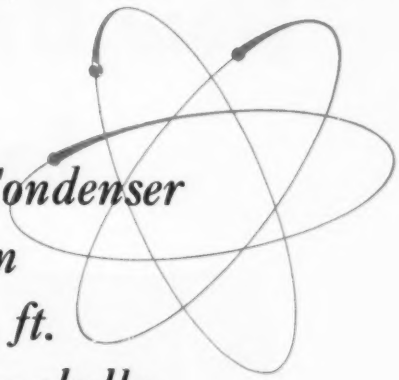
SIDE EXHAUST: Mounted directly on the turbine floor, the twin shells of this I-R condenser are connected directly to the dual side exhausts of a huge, cross-compound steam turbine serving a large mid-western utility. Such a condenser can be arranged for the most economical design proportions without the usual limitations of headroom and floor space.

AXIAL EXHAUST: This advanced-design I-R condenser connects directly to the exhaust of an axial flow exhaust turbine. The result of close cooperation between I-R engineers and the turbine designers, it is another outstanding example of the adaptability of I-R condenser design.

PUMPS • COMPRESSORS • STEAM JETS • CONDENSERS

Surface Condenser

NUCLEAR POWER PLANT



Advanced design I-R Condenser for Indian Point Station will contain 212,000 sq. ft. of cooling surface in two shells

SCHEDULED for completion in 1960, the Indian Point Nuclear Station of Consolidated Edison Company of New York, Inc., will pioneer many inovations in power plant equipment and design.

The I-R twin shell condenser serving the 275,000-kw turbo-generator unit will be the largest on the Con Edison system. The turbine is an 1800-rpm single shaft, double exhaust unit, and the condenser size is comparable to that of a unit serving a conventional 400,000-kw turbine. The two condenser shells will contain almost 180 miles of tubing with a total condensing surface of 212,000 sq ft. The 31,508 tubes will be welded at both ends into silicon-bronze tube sheets. Special hotwell trays will be provided with a total of 24 sampling connections to permit continuous indication of condensate purity.

Ingersoll-Rand will also supply the boiler-feed pumps, circulating pumps and steam-jet ejectors for the history-making Indian Point Station. The three specially-designed boiler-feed pumps will have a capacity of 2425 gpm at 632-psig discharge. And the two huge vertical circulating pumps will each handle 140,000 gallons per minute.

This outstanding installation is further evidence of Ingersoll-Rand's ability to meet *any* surface condenser requirements for any turbine-condenser arrangement. Your I-R engineer will be glad to discuss your power plant problems and help you determine the equipment best suited to your needs.

Ingersoll-Rand

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4-599

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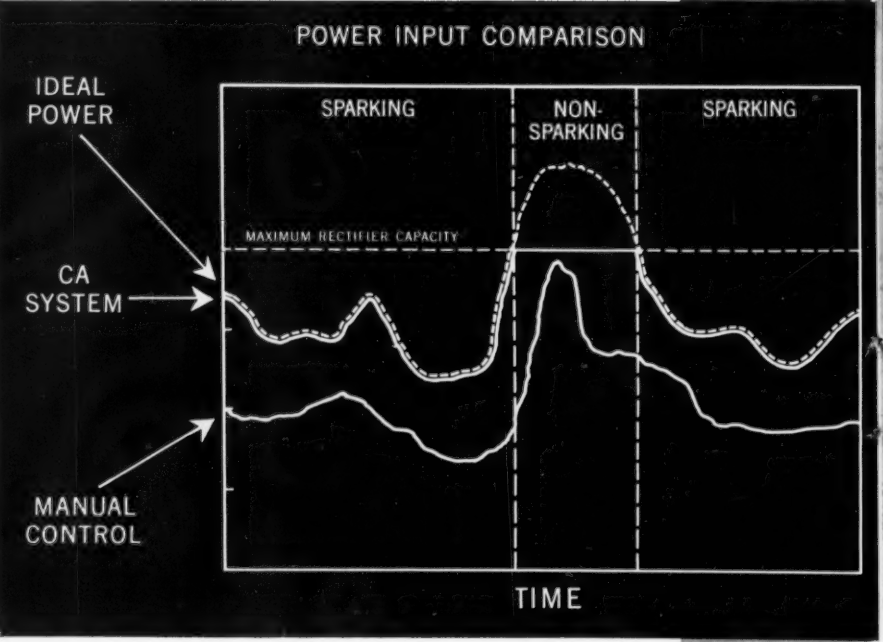
RESEARCH-COTTRELL'S

New CA System brings Auto

to precipitators

Higher "around-the-clock" collection efficiency without any manual adjustments. That sums up the major advantages of Research's new Cottrell Automation System.



The chart at the left shows how the CA System provides these advantages. As you know, ideal electrical power input to a precipitator is not constant. It varies with changes in gas composition, temperature, rate of flow and humidity, as well as characteristics of the dust, such as size, electrical resistivity and extent of build-up on the electrodes. With conventional controls, manual adjustments cannot keep pace with these changing conditions. This difference between *ideal* electrical power and *actual* power input, under manual control, is shown in the chart. This

mation

difference means lower collection efficiency. The fast acting electronic circuits of the CA System provide the best practical approach to ideal electrical power. During periods of sparking, electrical power input is controlled by the optimum sparking rate, which can be easily pre-set to any value between 0 and 500 sparks per minute. Under some conditions power input would have to be increased beyond the capacity of the electrical equipment in order to maintain this optimum sparking rate. During such periods the power input is governed by the *capacity* of the electrical equipment. This condition is shown in the center vertical section of the chart.

For more information on this new automation development write for your copy of Bulletin CA. It has a detailed description of how the Cottrell Automation System works and how higher "around-the-clock" collection efficiencies and lower operating costs are obtained.

Research-Cottrell

RESEARCH-COTTRELL, INC., Main Office and Plant: Bound Brook, New Jersey • 405 Lexington Ave., New York 17, N. Y.
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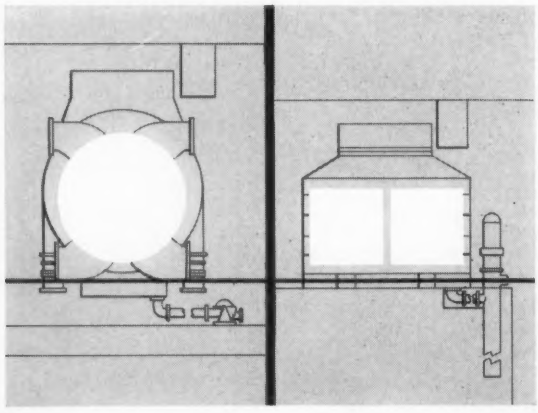
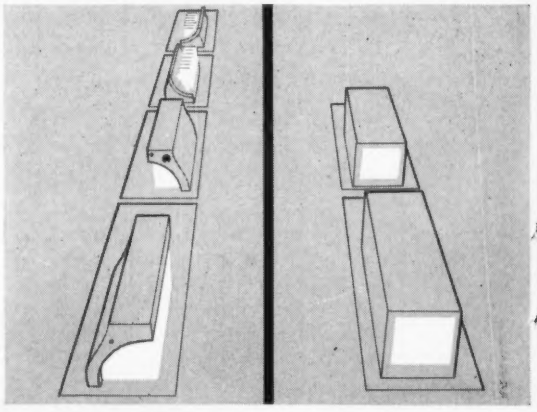
RC170

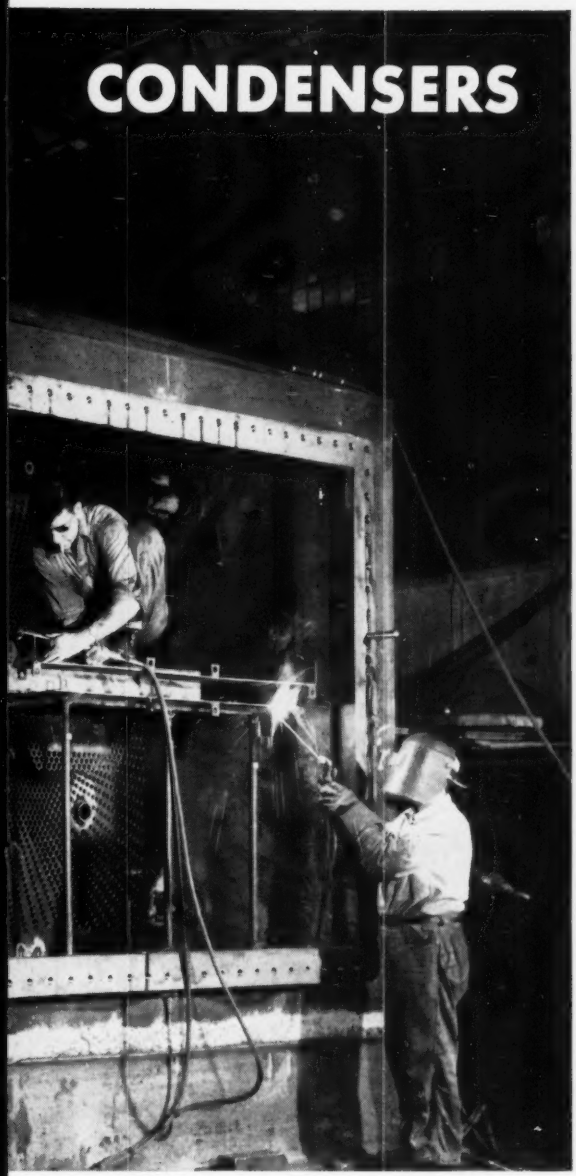
WESTINGHOUSE RECTANGULAR



Waste no space! Rectangular condensers require less headroom, fully utilize all space under turbine.



Faster installation! Rectangular condensers can be shipped in "bigger chunks" . . . less field welding.



...another great timesaver for station erection schedules

SAVE TIME—Basic simplicity of rectangular condenser design makes it possible to ship "bigger chunks of capacity." Building-block assembly speeds rigging; field welding is drastically cut. With its flat base, it is quickly and easily leveled. Westinghouse rectangular condensers can get you on the line faster.

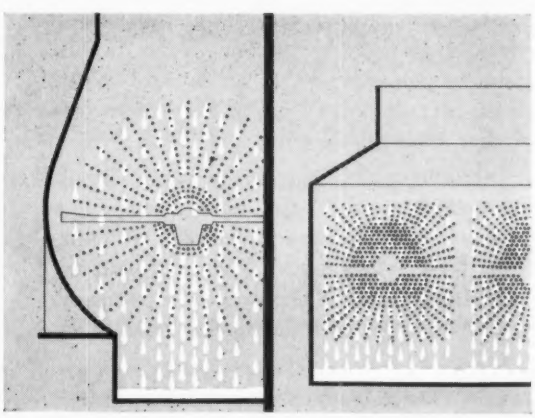
SAVE SPACE—As station ratings go higher and higher, equipment gets bigger. That's when space utilization takes on increasing importance. Westinghouse rectangular condenser design uses *all* the space under the turbine—*wastes none.*

BOOST EFFICIENCY—Two things, above all, you want from a condenser: Lowest possible absolute pressure, maximum reheating and deaeration of condensate. With its two-compartment radial-flow design and consequent short steam path to center air offtakes, a rectangular condenser provides lowest pressure drop. Uniform fall of condensate and the counterflow of steam from the lower steam belt liberate oxygen and assure deaerated condensate at saturation temperature.

Get the full story on Westinghouse condensers, circulating pumps, condensate pumps and air ejectors from your Westinghouse representative; or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50595

YOU CAN BE SURE...IF IT'S

Westinghouse

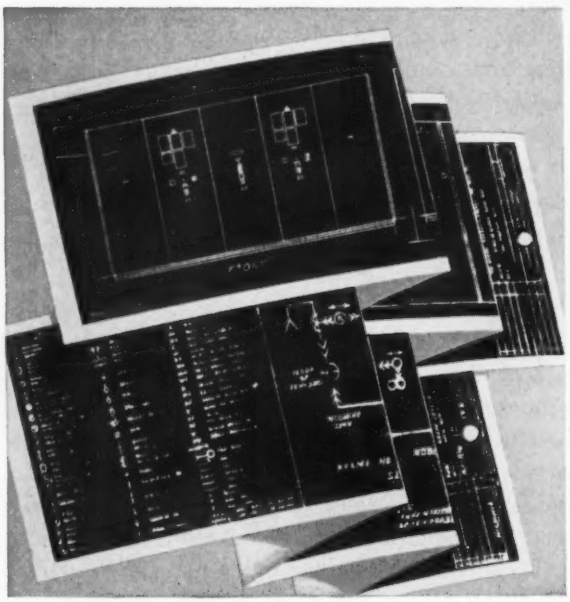


Boost efficiency! Lowest pressure with maximum reheat; condensate falls uniformly through belt of steam.

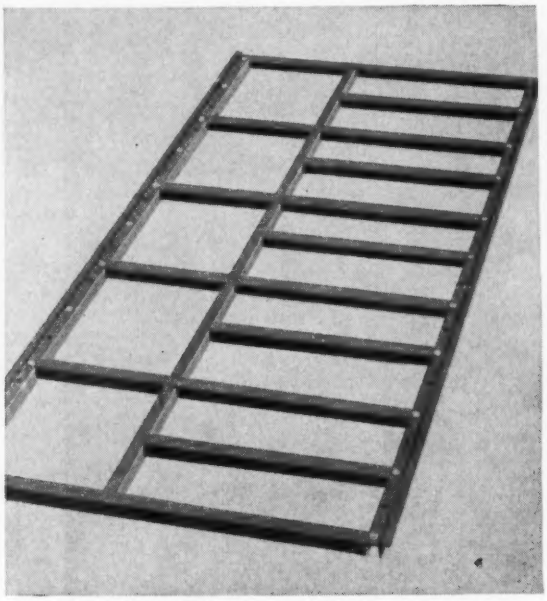
METAL-CLAD SWITCHGEAR

EASY INSTALLATION SAVES YOU TIME AND TROUBLE

I-T-E pre-engineers your installation before shipment... eliminates last-minute on-the-job fitting of switchgear to channel base



1. Complete drawings in advance. Shortly after placing your order, you will receive complete drawings showing the floor plan layout, outline dimensions, and single line diagram of the entire installation.



2. Prefabricated, painted channel base delivered first. Shipped upon request, well ahead of other equipment. Foundation bolt holes are pre-drilled to align with holes in switchgear housing.

Long before delivery of your I-T-E Metal-Clad Switchgear, you begin benefiting from the preliminary engineering and construction work which is a part of I-T-E's service to customers. It's another extra assurance of dependable performance you can expect from I-T-E equipment.

Floor plan, outline and single line drawings are supplied well in advance. Hence conduit can be run, floors poured, channel base set in place, and cables pulled. The switchgear, when it arrives, can be moved into position and connected according to plan quickly—saving you many installation hours on your premises.

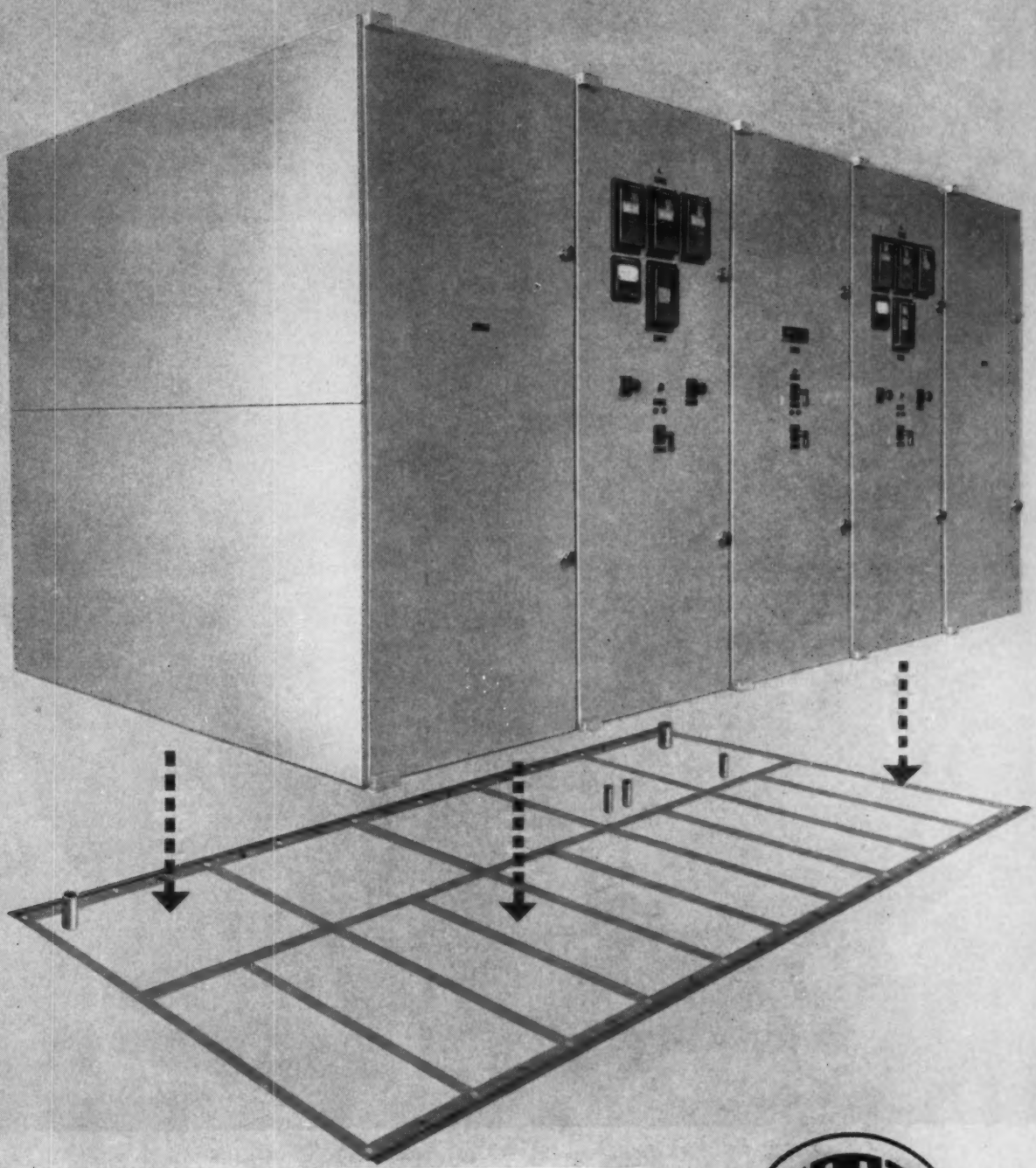
I-T-E's advance planning for you helps insure that your switchgear installation can be completed well within the time allowed by your construction schedule.

In addition, of course, you benefit from the superior engineering, design and construction of the various components making up an I-T-E switchboard—all of which contribute to its faithful trouble-free performance for years after the installation.

If you are planning new construction, get full details on I-T-E Metal-Clad Switchgear, rated through 13.8 kv, 3000 amperes continuous and 750 mva interrupting. Contact the I-T-E sales office near you. Or write for Bulletins 7004B and C. I-T-E Circuit Breaker Company, Switchgear Division, 19th & Hamilton Sts., Phila. 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY—Switchgear Division

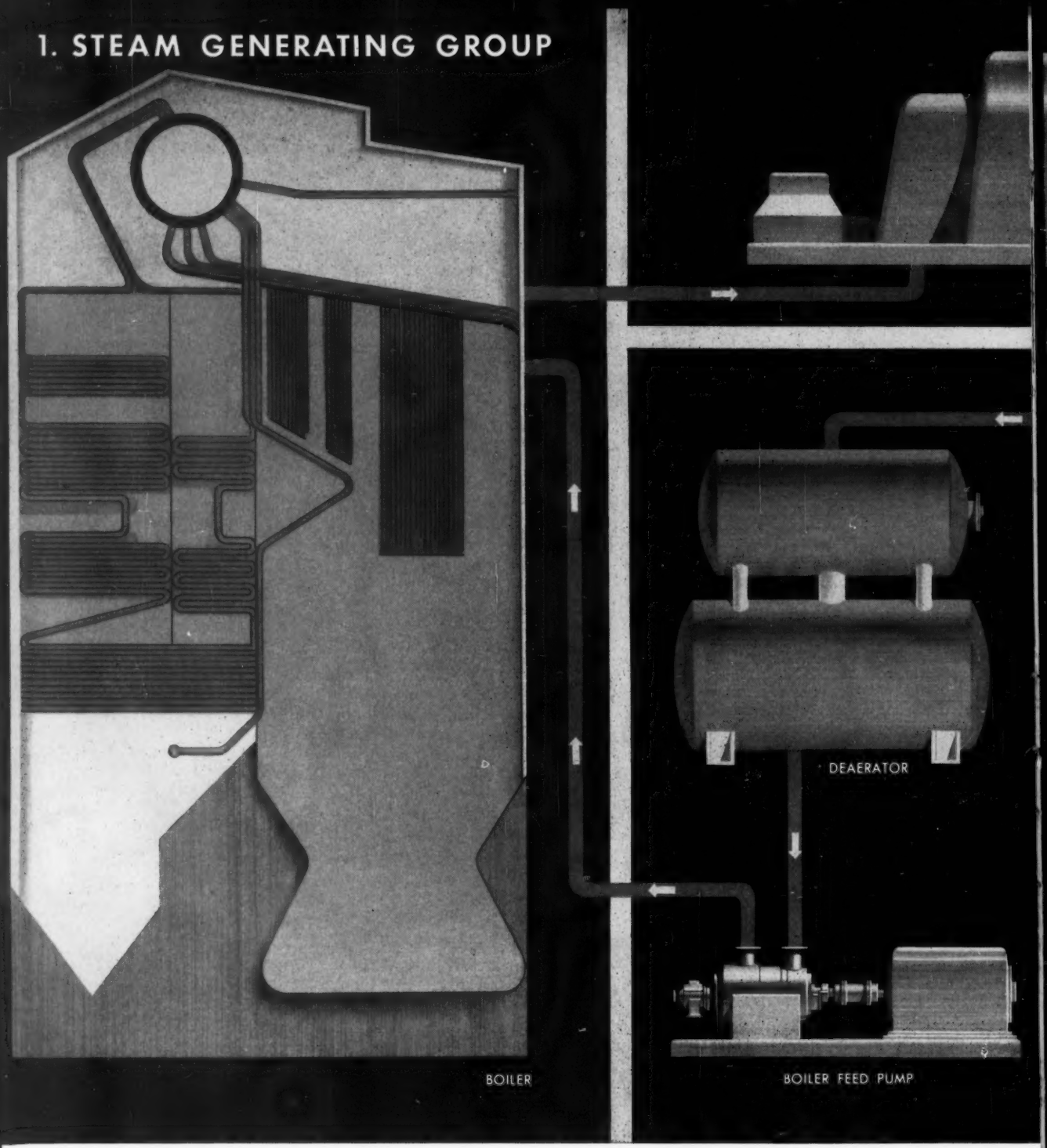
IN CANADA: EASTERN POWER DEVICES, LTD.



3. Sure fit—no delay. Channel base is embedded into the floor first. Then when switchgear is delivered it can be installed immediately. Sturdy I-T-E housings can be lifted in one piece by toe jack or chain hoist without distortion.

I-T-E

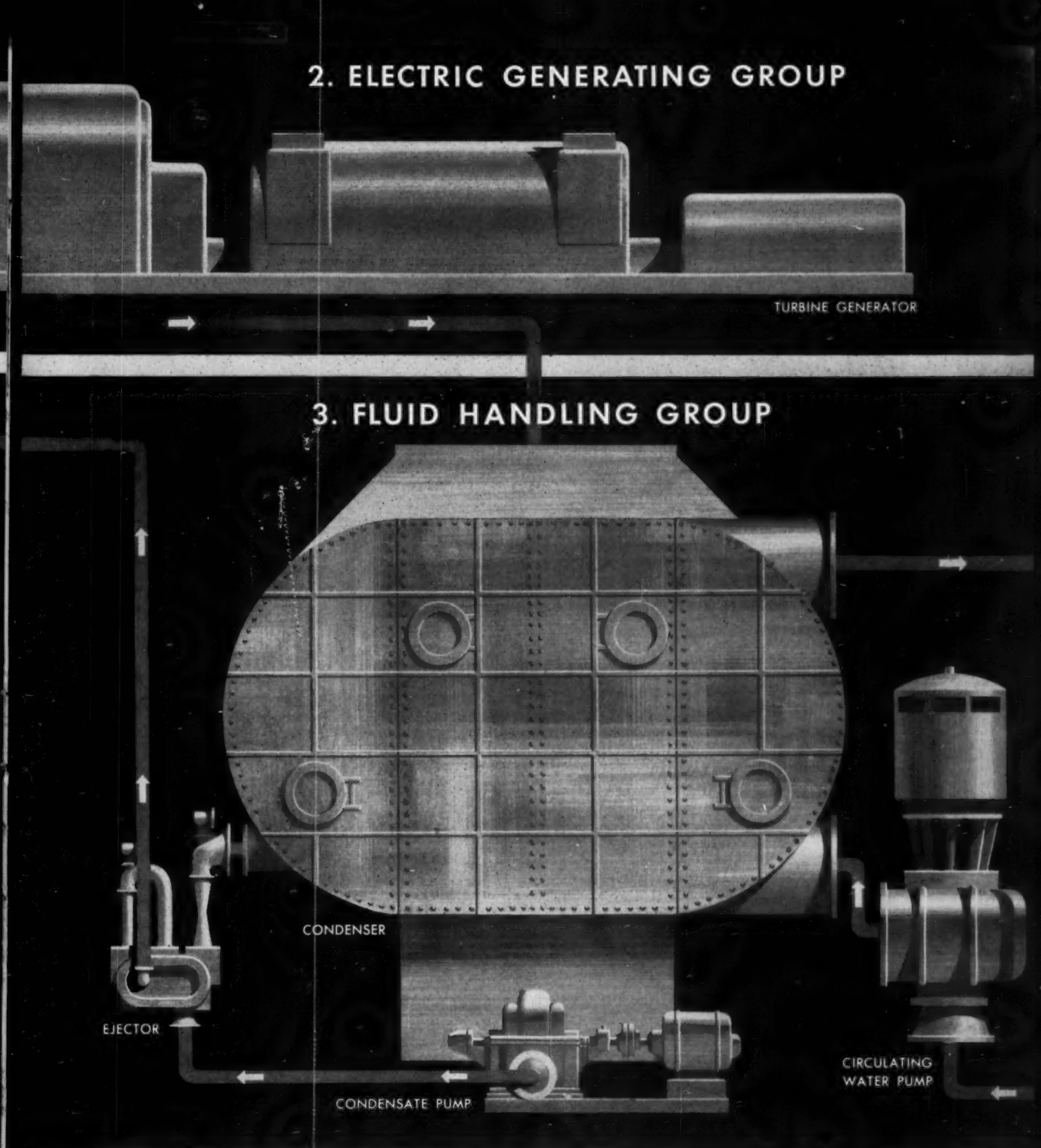
1. STEAM GENERATING GROUP



Look at all three

A new steam station design approach is bringing higher efficiencies, lower costs, and greater reliability. In this approach, only three basic functions are considered: (1) Steam Generating, (2) Electric Generating, (3) Fluid Handling. Station requirements are first analyzed in terms of the over-all job performed by each of these groups rather than by each individual piece of equipment.

Many of the benefits of this approach occur in the Fluid Handling Group. Here coordination and integration of the wide variety of equipment used can often effect substantial improvement in over-all operation. As steam temperatures and pressures go up, there are increased demands on the fluid handling function. Plant reliability often depends on the effect of one component of the fluid handling group on another during operational transients, either planned or of emergency nature. The solution is coordinated equipment

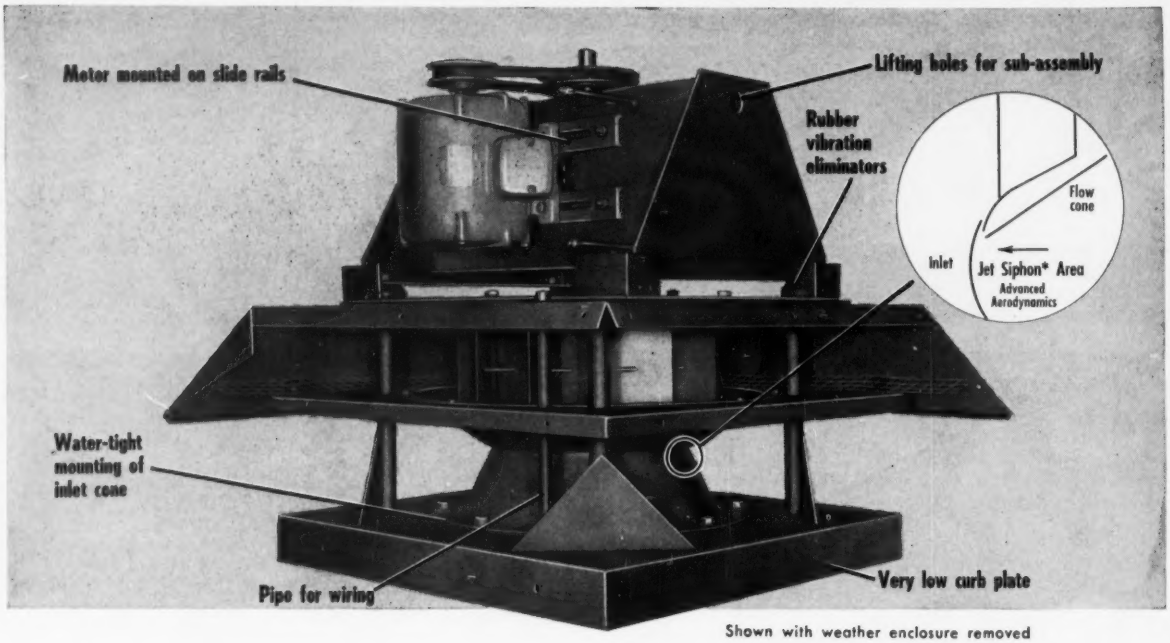


for power!

selection, engineering and design. And Worthington's "system" know-how and experience with modern complex plant cycles can help solve your fluid handling problems.

System-wise experience As the manufacturer of all major components of the Fluid Handling Group, Worthington has a reservoir of experience and knowledge that can be of benefit to you. To put this "system-wise" experience to work for you, get in touch with your nearest district office. Or write to section C-71, Worthington Corporation, Harrison, New Jersey.

WORTHINGTON



Shown with weather enclosure removed

PLUS VALUES... all yours in the Clarage Centrilator

POWER ROOF VENTILATOR — CENTRIFUGAL TYPE

Jet Siphon* feature for stable, high efficiency.

Static pressures to 2" — thus well suited to both light-duty installations without ductwork and applications where ductwork or hoods impose considerable resistance.

Adaptable to a wide range of motor sizes.

Variable pitch V-belt drive.

Wheel and inlet designed for streamlined air flow.

Built heavy-duty throughout to assure long-lasting, trouble-free service.

Every wheel statically and dynamically balanced on precision machines.

Inspection panel and complete accessibility.

Low overall height.

Venting of motor and drive area.

Engineered and constructed for extra quietness.

Heavy-duty anti-friction bearings.

Simple installation — only 4 bolts required.

Write today for Bulletin 550. Clarage Fan Co., Kalamazoo, Mich.

CLARAGE ...dependable equipment for making air your servant

*Patent applied for

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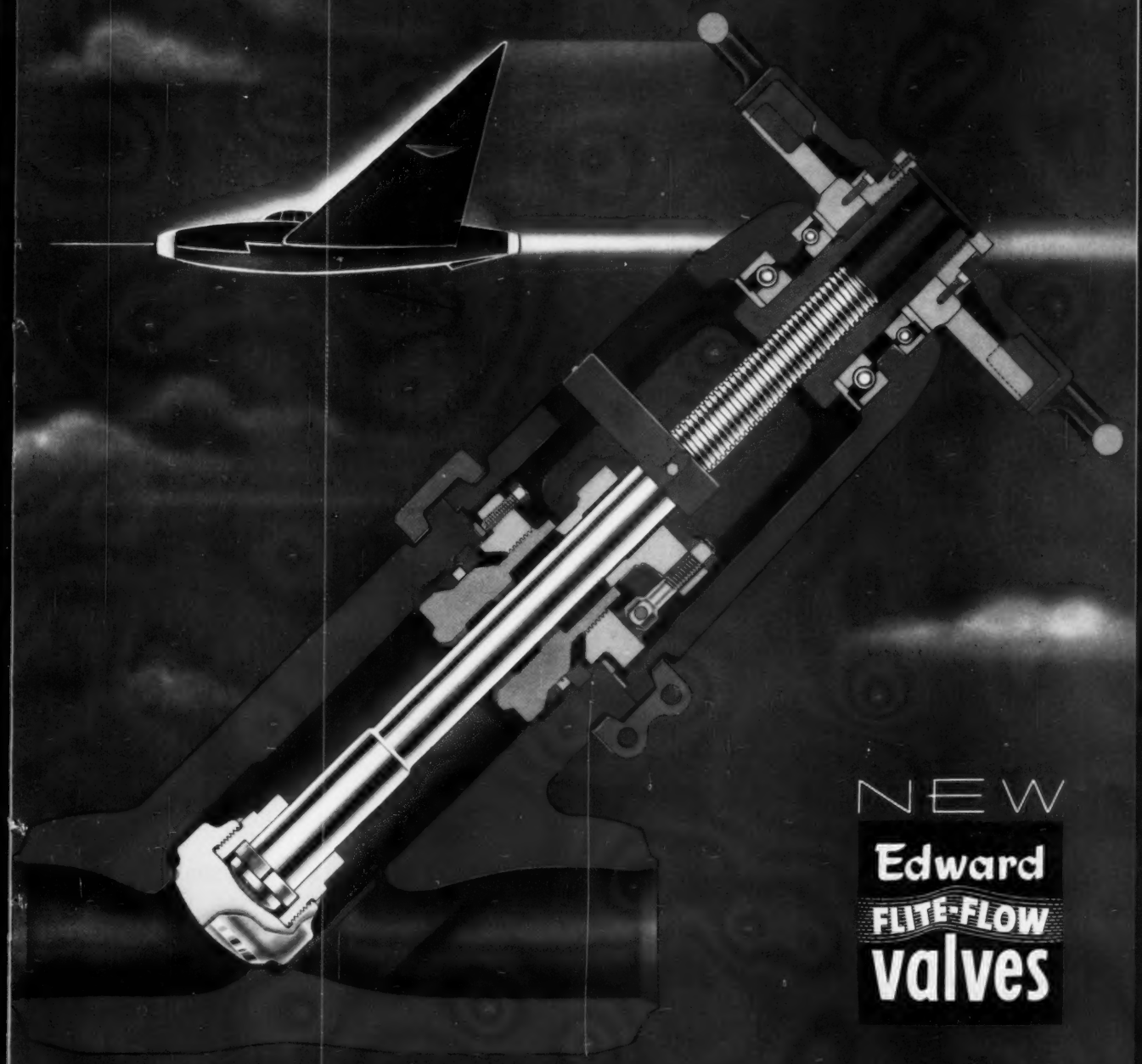
Edward valve values

Edward Valves, Inc. Subsidiary of ROCKWELL MANUFACTURING COMPANY
EAST CHICAGO, INDIANA

SECOND QUARTER 1957



NEW
Edward
FLITE-FLOW
valves

EDWARD VALVE VALUES

Improvements Built Into New Feedline Stop-Check Valve

One of the most popular of Edward power plant valves—the separated type feedline stop-check valve—has been redesigned to include features that further improve its operation.

The Edward separated stop-check valve—available in pressures from 600 lb to 1500 lb psi and sizes from 2½ in. to 8 in.—has been specified in power plants for a quarter-century. As the valve has two separate disks and seats combined in a single body, it conforms to the Boiler Code Requirements, paragraph P-317 (b).

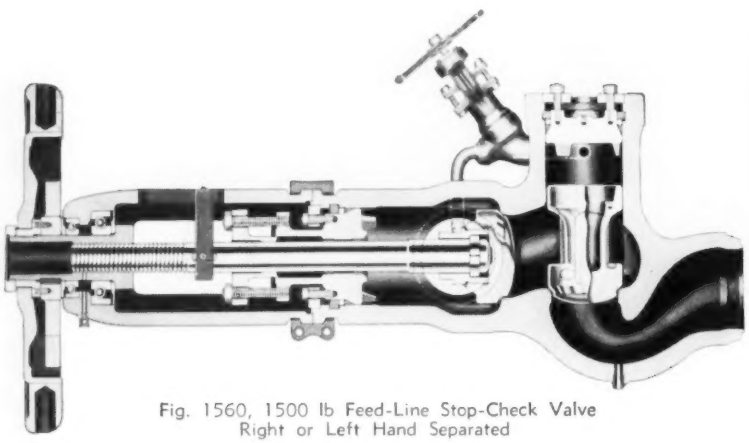


Fig. 1560, 1500 lb Feed-Line Stop-Check Valve
Right or Left Hand Separated

The separated stop-check valve line has been redesigned to incorporate new casting procedures developed by Edward research programs. Strength and durability factors also have been increased to further add to the longevity of the valve. A continuous ring of Stellite, applied directly to the body, machined in the same set-up with the body bore for perfect alignment, forms a hard faced seat. The disk is Stellite on alloy steel.

Internal modifications have been made to the valve body to add strength and reduce pressure drop. The patented Edward Equalizer, which gives higher lift, lowers pressure loss and eliminates wear-producing vibration also has been added, to make the new stop-check valves the first ever to have this exclusive feature.

CONTENTS

Improvements built into new feedline stop-check valve.

Technical Tips — Flow index data simplify valve selection.

New Edward FLITE-FLOW valves for process steam-electric power plant.

New design brings high value to low-priced instrument valves.

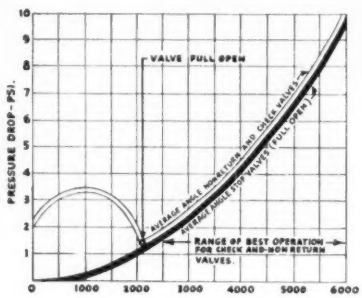
Technical Tips

Flow Index Data Simplify Valve Selection

Best initial, maintenance and operating economy is obtained when valves are properly sized to individual installation requirements.

Too small a valve will have too high a pressure drop and waste power. Too large a valve is a waste of money and requires unnecessary effort to close. If a non-return or check valve is too large, the disk may hug the seat at low flows causing vibration and wear.

The Edward Flow Index has been devised to simplify the specification of valves. The index indicates flow corrected for density in pounds per hour per square inch of port area. Graphs (Typical graph shown below) showing pressure drop vs increase in the Edward Flow Index have been prepared for all Edward valves. Copies are available upon request from regional sales representatives or by writing to the East Chicago headquarters.



$$W\sqrt{V}/A = \text{FLOW INDEX}$$

The following data are all that are required for use of the index:

W = Flow rate in pounds per hour

$\sqrt{v}$ = Square root of specific volume (at operating temperature and pressure) of fluid in cubic feet per pound. Tables available from Edward Valves, Inc., contain these data.

A = Port area of valve in square inches. (This is listed in Edward catalog 105.)

Insertion of the figures into the formula,

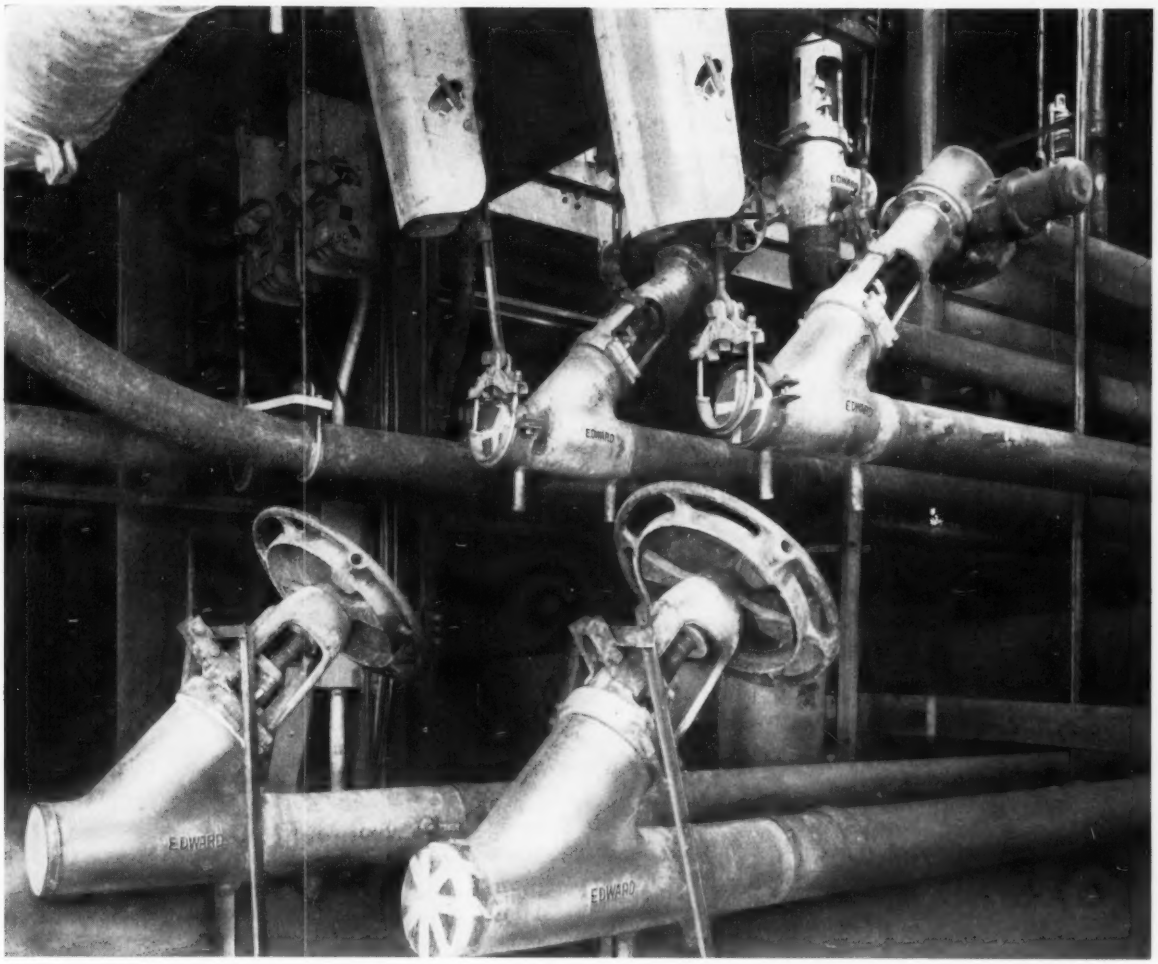
$$\text{Edward Flow Index} = \frac{W\sqrt{v}}{A}$$

provides the required flow index value.

Reading up from the flow index value on the chart to the curve gives the pressure drop in psig for a specific series of valves.

COVER PHOTO

"Flite-Flow" is the descriptive name given to a new Edward line of globe type valves which cut pressure drop to new lows while assuring tight shut-off under all pressure-temperature conditions. See facing page for story.



Installation of Edward Flite-Flow valves in Public Service Electric and Gas Co. 450,000 kw generating station at Linden, N. J. Photo taken during piping erection.

Research Points the Way to . . .

New Edward Flite-Flow Valves For Process Steam-Electric Power Plant

A bold new approach to lower cost electrical power is rapidly nearing completion at Linden, N. J., where Public Service Electric and Gas Co. is erecting a 450,000 kw generating station.

Design of the plant was dictated by a unique combination of two major industrial processes — power generation and oil refining. The Linden station is located adjacent to the Bayway Refinery of Esso Standard Oil Co. Esso and Public Service entered into an agreement whereby the refinery will supply residual oil as fuel to the power plant in return for steam required in the refining process.

Providing steam to a refinery, while offering significant economy and efficiency through a low-cost fuel supply and reduction of the usual condenser thermal losses, involved major complications in the piping plan.

Flite-Flow Valves Are Solution

Edward valve engineers, by developing a completely new line of high pressure-temperature globe

Rockwell-Built EDWARD VALVES

type valves with lower pressure drop than any previous design, made the use of globe valves practicable. This line, the brand new *Flite-Flow* Edward Valves, is available in globe stop, non-return and piston check designs.

A distinguishing feature of the Linden power plant design is the provision of three boilers to supply one 225,000 kw double-extraction turbine-generator. This departure from recent power plant theory — which emphasizes using one boiler per turbine — assures reliability of steam supply to the refinery. Two boilers are sufficient to operate the unit with full extraction flow from turbine.

The second 225,000 kw turbine will be supplied by one boiler. Unit has sufficient capacity to meet future steam needs when the refinery is expanded.

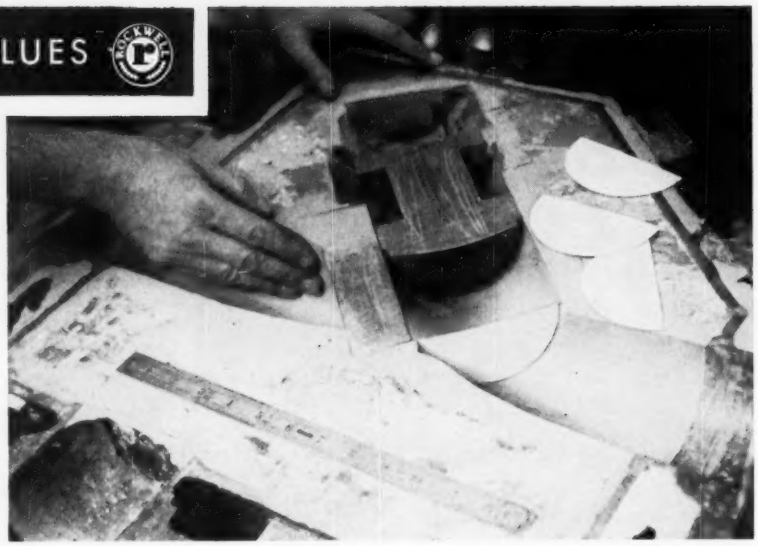
Globe Valve Advantages Important

Early discussions between the utility and Edward Valves engineers led to specification of globe valves, rather than traditional gate valves in main steam, header and feedwater lines. Advantages of absolute seat tightness and easy repair of seats had been proved in earlier Edward power valves.

However, Linden station operating conditions — 2,737,000 lb/hr @ 2000 psig turbine supply and 400,000 lb/hr @ 750 psig plus 750,000 lb/hr @ 150 psig extracted process steam — required that pressure drops be held below those of any globe valve previously built.

To succeed, Edward designers required a line of valves with these characteristics:

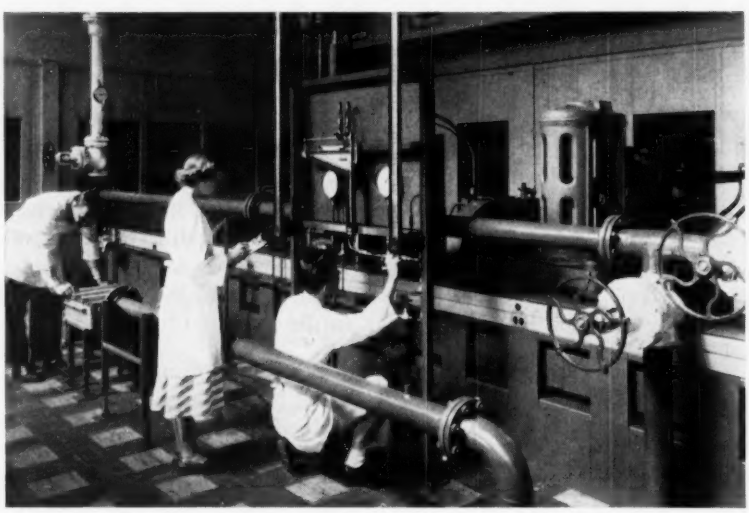
1. Drop tight shut-off must be provided under all pressure-temperature conditions.
2. Wide range of thermal differentials to be expected under varied piping systems must be met.
3. Seats must be drop tight under high hydrostatic pressures.
4. Seating repairs must be possible with minimum downtime without removing the valve from the line or using special equipment.
5. Pressure drop in the 500,000 to 3,000,000 lb/hr range must not be more than four times that of the best gate valve design.
6. Installation in a straight pipe run — not merely at corners — must be practical.



Slide rules can help only so much. Then skilled hands are required. Half section models are molded of plastic with care and precision. These are the designer's most valuable tools. They alone tell whether the theory is correct, the calculations accurate.

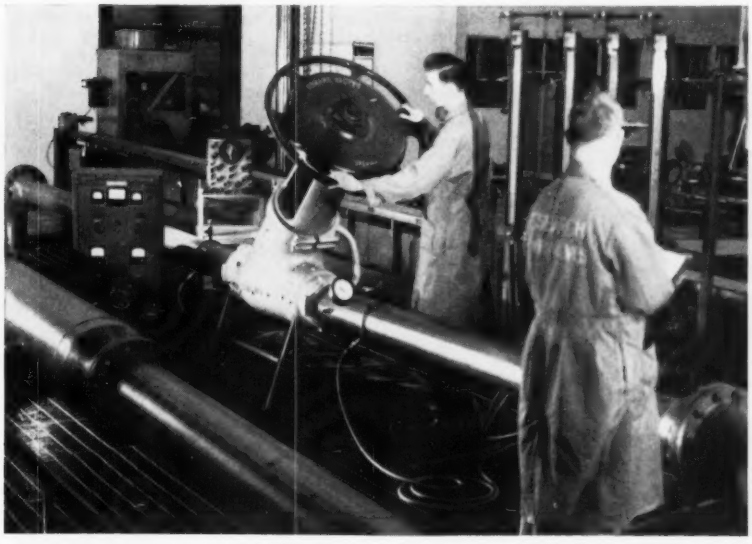
Predictions Based on Research

The designers knew from their work on other Edward valves that it was possible to cast a valve body



Repeated design changes are made. A few hundredths of an inch removed here, a little material added there. Each modification is checked in the line in thorough investigation of flow characteristics.

Best shape having been determined, accurate extrapolation to full size pattern follows. Plaster cast helps check pattern accuracy — permits metallurgists to recommend foundry procedure for best casting quality.



Water flow tests of finished stop valve simulate service flow conditions. Tests confirm pressure drop results of half model research; establish flow characteristics for varying disk positions.

with physical and metallurgical requirements to meet the high temperature-pressure conditions expected.

It was not so easy, however, to know whether pressure drop requirements could be solved. Research that had produced the streamlined Edward 90° stem, angle and elbow-down valves indicated that further studies might result in satisfactory reduction.

First step in the program to develop the new valve line was an approximation of body design through theoretical stress calculations, also based upon extension of earlier work. Although these data could not be expected to give the final body dimensions, they made it possible to rough out the shape for study by casting engineers.

Plastic Models Tested

Meanwhile, a series of cross-section models of the valve interior were made of plaster and plastic and subjected to flow test. Modifications dictated by experimental results were made repeatedly until turbulence and pressure drop had reached a minimum.

Models of the final valve body were made for study by pattern and casting quality control engineers. This step was essential to be sure that the designs could be executed without unnecessary production complications. Minor changes were made to facilitate casting and provide an extra margin of strength without reducing the flow characteristics.

Thorough testing of full-size pilot models followed: Incoming castings were given initial radiographic and magnetic particle inspection — standard Edward procedure on large heavy-duty valves —and numerous metallurgical checks during manufacture. Machined bodies were re-radiographed as a final safeguard

Rockwell-Built EDWARD VALVES

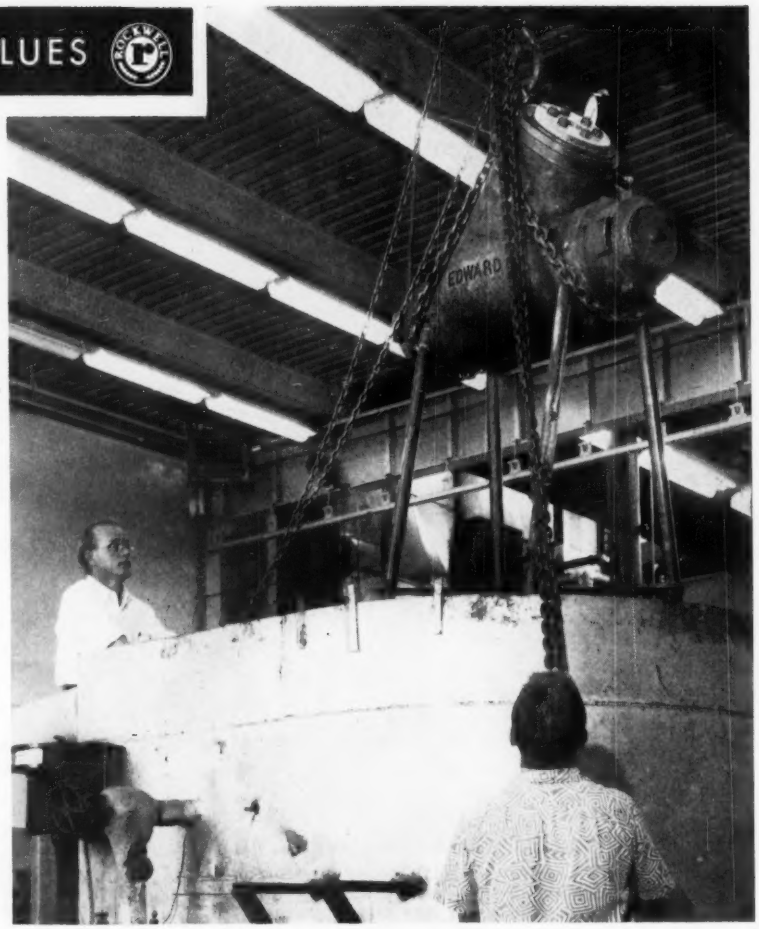
and then the assembled valves subjected to extensive heat and pressure testing.

Detailed brittle lacquer and strain gage records were made. All tests were passed. With physical quality assured, extensive flow tests began.

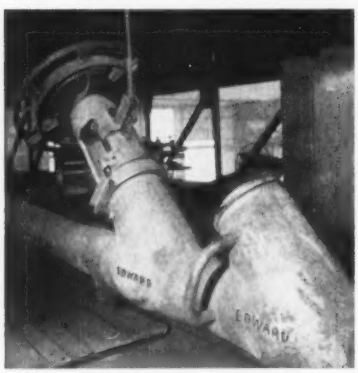
One of the most dramatic tests was a creep test which simulated a service life of approximately 40 years at rated pressure and temperature. Following previously proved test methods, Edward engineers placed a check valve in a furnace at its rated pressure and higher than rated temperatures for a period of 1000 hours.

A careful check of valve body dimensions both before and after the test revealed a maximum creep of .010″ in 10″, which is well within allowable limits. At pressures ranging from 600 psi to 2500 psi the valve closed drop tight, and at 30 psi the seat and disk leaked only ¾ cc per minute. There was no leakage at the bonnet joint.

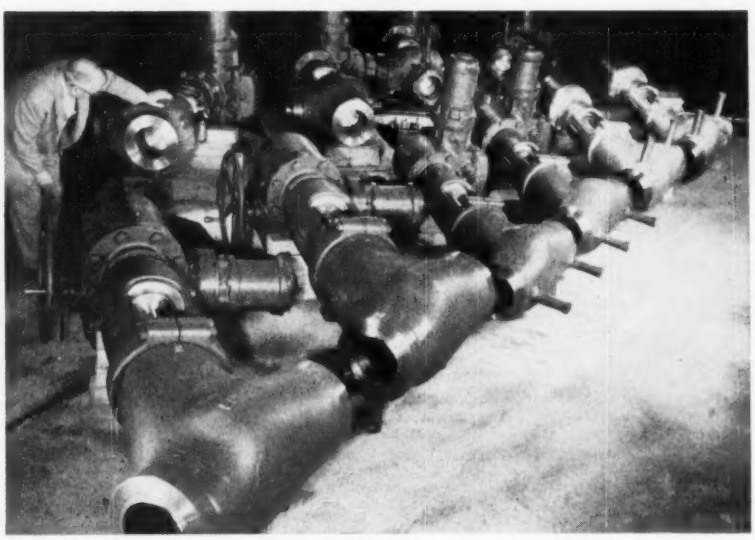
Success in this "final exam" meant that the new *Flite-Flow* valves were ready for production. The designers had reached their goal.



Forty years of service life at rated pressure and temperature is simulated in this accelerated high temperature furnace test of Flite-Flow check valve. The test revealed a maximum body creep of only .010″ in 10″. The valve closed drop tight at pressures of 650 psi and up, and the seat joint leaked a mere ¾ cc per minute at a pressure of 30 psi. No leakage at the bonnet joint.



Two of the first Flite-Flow valves to be installed at the new Linden Station — stop valve (left) and check valve (right).



Fulfilling the research objectives, (1) to build valves permanently dependable for tight shut off (2) to have lowest possible pressure drop (3) to be repairable in the line — rugged appearing Flite-Flow valves are ready for shipment.

New Carbon Steel Instrument Valve With Hard-Faced Seat

New Carbon Steel Valve With Integral Hard-Faced Seat Resists Wear As Well As 416 Stainless Valves. Costs Less To Weld.

Edward 952 series carbon-steel instrument valves have been redesigned to provide resistance to seat wear previously available only in 2952 and 2953 series 416 stainless steel valves.

In the seven years since the original models were introduced, Edward instrument valves have been widely used where a small stop and variable flow valve must be fitted into limited space. Instrument piping has been the most common application, but large numbers are used in oil field Christmas trees, by-pass lines and installations where highly corrosive liquids or gases are carried in relatively small lines. The stainless body 2952 and 2953 series will continue to be available for applications requiring extreme corrosion resistance.

Handle Up to 6000 lb

All Edward carbon steel and stainless instrument valves are rated at 6000 lb (water, oil or gas) at 100 F. Carbon steel valves are rated 2500 lb at 850 F while stainless valves are rated 1500 lb at 1000 F. They are available in globe and angle designs with screwed or socket welding ends.

Redesign was begun after analysis indicated that many stainless steel valves — originally intended for corrosive fluids — were going into non-corrosive applications. Investigation showed that many customers preferred to pay the extra costs of stainless steel and complicated procedure of welding alloy valves to carbon steel piping in return for the alloy's greater wear resistance.

The extra price, customers said, was a small premium to pay for a valve that could reduce the need of dismantling instrument piping due to a worn or corroded valve seat.

Simpler Solution Provided

Edward engineers provided a simpler solution by redesigning the 952 series carbon steel instrument valves to incorporate special integral seat inserts of a hard chrome-cobalt-tungsten steel.

EValloy stem-disks retain the exclusive Edward features that have proved successful in the thousands of instrument valves installed since 1950. They are centerless ground for smooth packing contact and incorporate an integral needle point for precise flow control.

Other Edward features include improved swing bolted gland design that permits easy repacking without disassembly or removal of the valve from the line. Repacking is minimized by EValpak die molded packing that is treated to prevent stem pitting.

Tests Assure Quality

Bodies and yokes are of drop forged steel for extra strength. Bonnetless construction eliminates bonnet joint leakage.

Three production inspection tests assure that each valve is strong and will seat tightly.

Integral seat ring of Cobalt-Chromium-Tungsten alloy gives corrosion-erosion resistance.

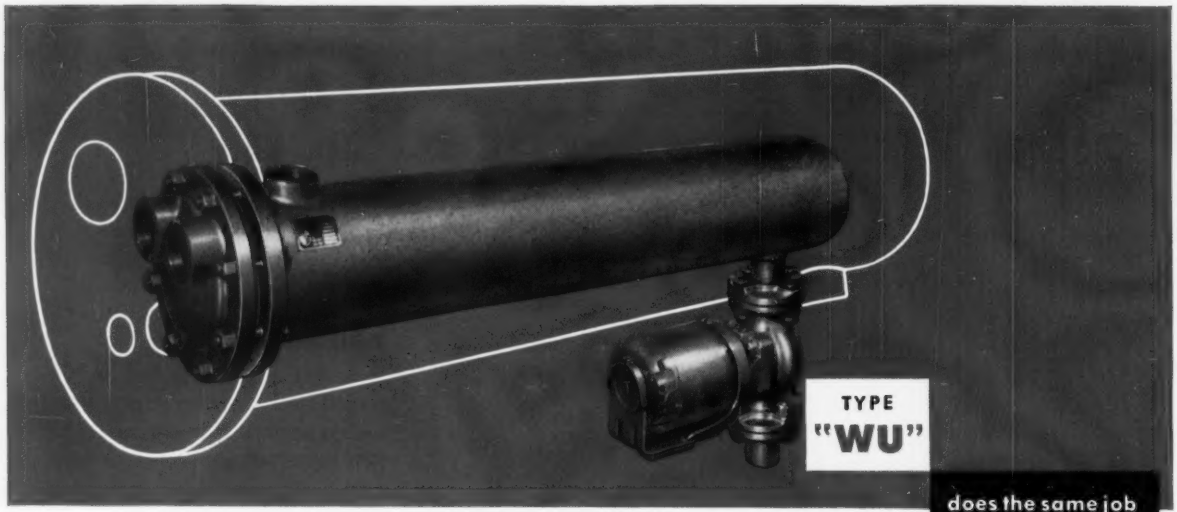
Write For EDWARD BULLETIN 571

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

1230 West 145th Street

EAST CHICAGO, INDIANA



does the same job as a much larger gravity circulated heater

More hot water from a smaller heater

Pumped boiler water circulation steps up capacity ...permits close temperature control

The B&G Type "WU" Heat Exchanger is an extremely versatile, instantaneous water heating unit, with a wide range of applications. It is equipped with a B&G Booster which pumps boiler water through the properly baffled shell, thereby greatly increasing the capacity of the heater. Large volumes of hot water are produced by amazingly small units.

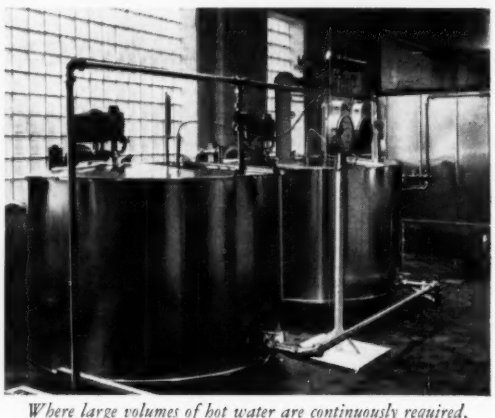
Controls service water temperature

A hot water control, installed in the hot service water line, starts the Booster whenever water temperature goes below the desired degree. Boiler water is pumped through the shell of the "WU" until service water is again at the correct temperature.

Slashes material and labor costs

Because of pumped circulation, the connecting pipes and fittings can be radically reduced in size. Material cost is trimmed to the bone and cutting and threading can be done on the job. No storage tank needed—another substantial saving.

"WU" Heat Exchangers can be installed on hot water boilers or below the waterline of steam boilers.

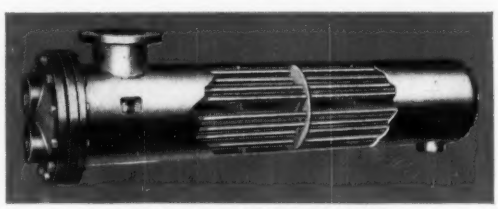


Where large volumes of hot water are continuously required, the "WU" is an economical producer

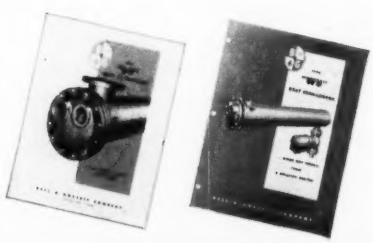
B&G TYPE "SU" HEAT EXCHANGERS for steam-to-water heat transfer

The "SU" Heat Exchanger is an instantaneous type—no space wasting, expensive storage tank required. It can be connected to any steam boiler or system and has numerous water heating applications in industrial and process plants.

"SU" Heat Exchangers are made in either 2 or 4 pass units, with ratings through a wide range of steam pressures. ASME construction is available for certain pressures without extra charge.

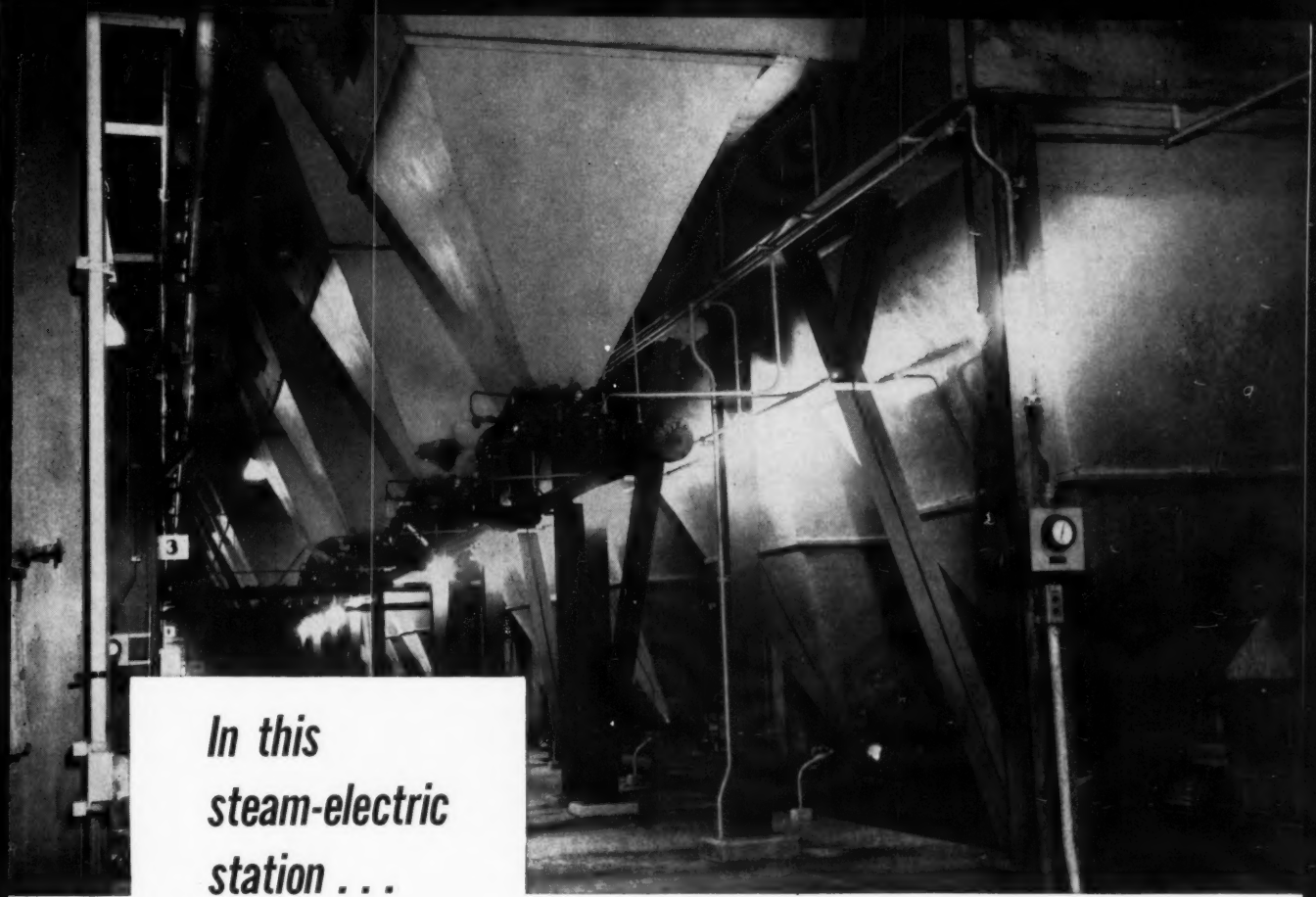


B&G TYPE "SU" HEAT EXCHANGER
...for heating water with steam



Send for catalogs on B&G "WU" and "SU" Heat Exchangers

BELL & GOSSETT
COMPANY
Dept. EV-36, Morton Grove, Illinois
Canadian Licensee: S. A. Armstrong Ltd., 1400 O'Connor Drive, Toronto 16, Ontario



In this steam-electric station . . .

USS "T-1" Steel resists abrasive action of 14,000 tons of coal every day!

28 million pounds of abrasive coal scour through this large power generation system every day! To insure good service and durability, USS "T-1" Steel is used at points of severe wear in coal chutes, hoppers, pulverizer feed pipes, exhaust pipes, and liners of ash collectors.

USS "T-1" Steel's exceptional *combination* of properties suits it ideally for equipment like this. Here's how "T-1" Steel cuts maintenance, repair and installation costs:

"T-1" Steel Lengthens Service Life. For maximum resistance to impact-abrasion, USS "T-1" is furnished quenched and tempered to 321 minimum Brinell. It is recommended wherever impact abuse is severe. Chutes, hoppers, ducts and similar equipment last longer when built with USS "T-1" Steel—especially when they must withstand abuse at sub-zero temperatures.

"T-1" Steel Reduces Weight. USS "T-1" Steel is also furnished quenched and tempered to 90,000 psi minimum yield strength, enabling designers to reduce the thickness of steel used in many supporting structures requiring both bars and fabricated plates. This reduces weight, reduces the amount of welding, cuts freight costs, and at times even lessens foundation requirements.

"T-1" Steel Is Weldable. Whether USS "T-1" Steel is furnished to 321 minimum Brinell or 90,000 psi minimum yield strength, it can be welded in the field *without pre- or post-heating.* This weldability—unique in a steel so strong and durable—permits on-the-spot fabrication at minimum cost.

Write for our new illustrated booklet "T-1" which contains design and application information, as well as helpful hints on fabrication of this versatile alloy steel.

UNITED STATES STEEL CORPORATION, PITTSBURGH
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

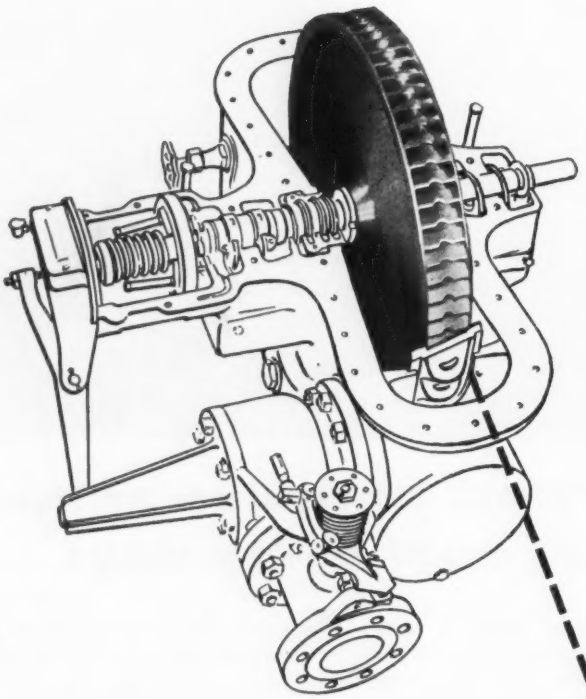
USS "T" CONSTRUCTIONAL ALLOY STEEL

"USS," "COR-TEN," "MAN-TEN," "TRI-TEN," and "T-1" are registered trademarks.

Other well-known USS steels used in coal handling systems are USS Stainless, USS Cor-Ten, USS Tri-Ten, USS Man-Ten and USS A-R steels.

UNITED STATES STEEL

Work Horse of Industry..since 1906



The Terry Steam Turbine Company was incorporated in 1906 to manufacture *a workable and efficient prime mover that would operate with minimum maintenance.* This prime mover was the solid-wheel turbine, which had been invented by Edward Clinton Terry a few years before.

Although maintenance practice has improved vastly since then, the demand for the turbine has multiplied many times. *Rising maintenance costs have actually increased the need for trouble-free operation.*

Today, there are more Terry solid-wheel turbines in operation, and there are more built each year, than ever before. The explanation is simple.

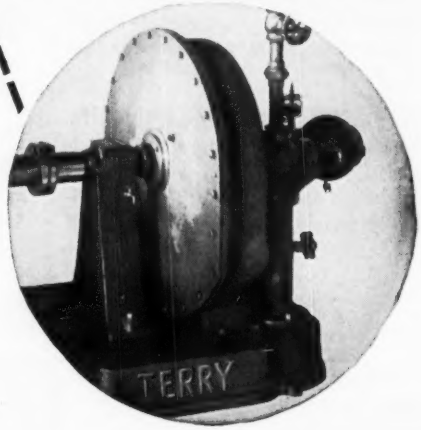
Here is a turbine with a virtually indestructible wheel. Made of a single forging of special composition steel, there are no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which may occur does not materially affect horsepower or efficiency.

Blades will not foul. They have large clearances and are further protected by the projecting rims at the sides of the wheel. As the side clearances are also very large, end play can do no harm.

These are a few of the reasons why the Terry solid wheel turbine has been the *work horse of industry — since 1906.* For the full story, send for a copy of Bulletin S-116.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY



1906 was the year this turbine was built in Terry's plant. It is believed to be one of the first small direct-connected turbines built for commercial use in the United States.

TT-1203

Always Stronger Than They Need Be!

MIDWEST

WELDING FITTINGS

Below are photographs of two of the many tests that have been made of Midwest Welding Fittings. The results are *always* the same . . . the seamless pipe to which the fittings are welded invariably bursts. There is *never* any sign of fitting failure or weakness.

There's good reason for this. We make elbows and tees of inherently stronger metal . . . the Midwest exclusive method of manufacture enables us to maintain greater minimum wall thickness, and to reinforce the fittings at points of greatest stress. For the many other advantages of Midwest Fittings, ask your Midwest distributor or write us for Catalog 54.

MIDWEST PIPING COMPANY, INC.

Main Office: 1450 South Second St., St. Louis 4, Mo.

PLANTS: ST. LOUIS, CLIFTON, N. J. and LOS ANGELES

SALES OFFICES:

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ONEIDA, N.Y.—282 NORTH MAIN ST. • SAN FRANCISCO 11—420 MARKET ST.

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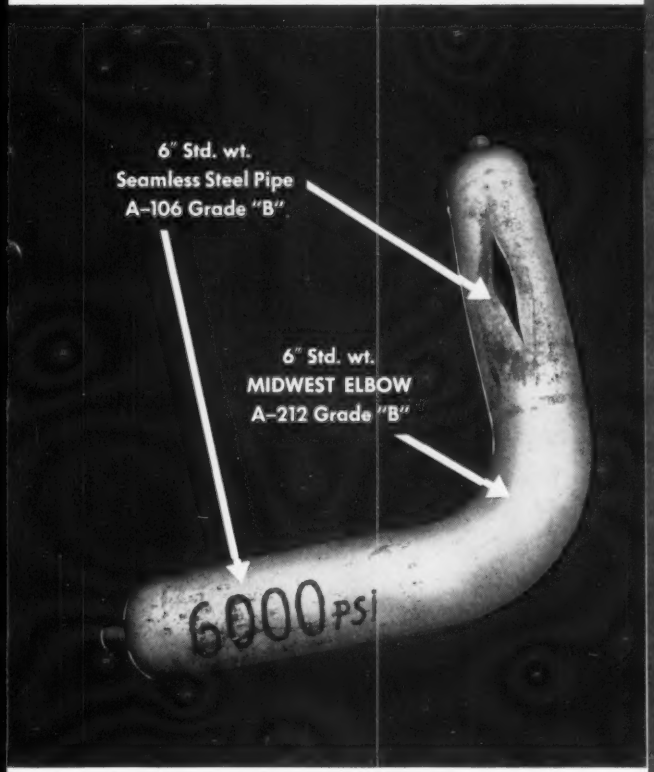
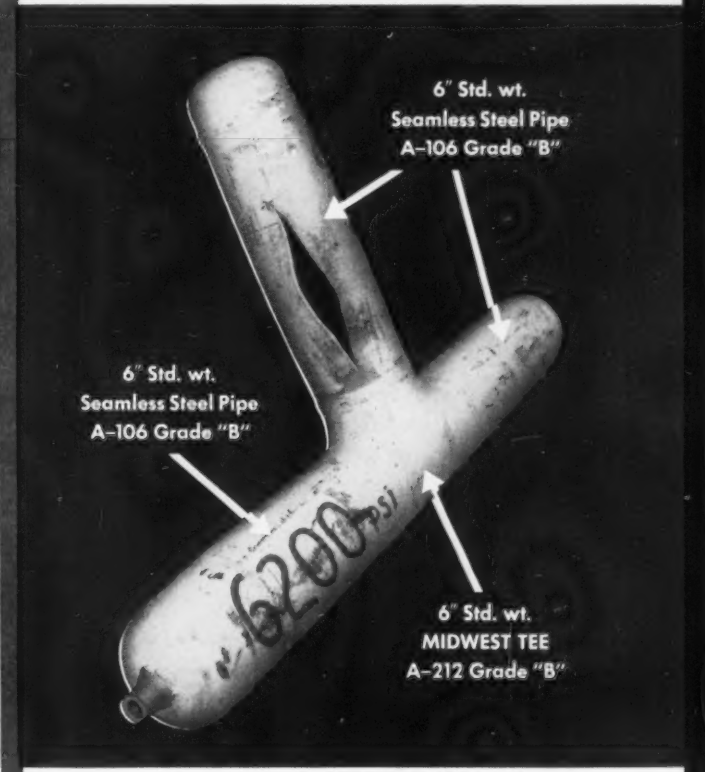


Typical bursting test of stock Midwest Welding Elbow. As is always the case, failure occurred in the seamless pipe while the elbow was undamaged. Bursting pressure was 6000 psi . . . considerably above the required code minimum for seamless pipe. (Minimum allowable bursting pressure for 6" standard weight A-106 Grade B seamless steel pipe is 4438 psi.)



Bursting test of Midwest Welding Tee taken at random from stock. As always, the failure occurred in the seamless pipe and not in the fitting. The non-shock internal bursting pressure of 6200 psi is well above the code minimum for seamless pipe. (Minimum allowable bursting pressure for 6" standard weight A-106 Grade B seamless steel pipe is 4438 psi.)

7761

MIDWEST **WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS**

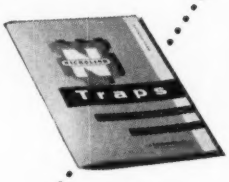
stop condensate backup

Nicholson steam traps discharge condensate and air from steam lines and equipment *faster* than any other trap of comparable size . . . help you make full use of your steam dollar. The reason—the effective use of a large orifice. A ½" Nicholson trap has a greater discharge capacity than most 1¼" traps . . . and costs less, too!

And that's not all. With just one thermostatically-operated moving part, there's nothing to get out of order, nothing to go wrong. Nicholson means continuous and low-cost operation of your steam-using equipment . . . no downtime from trap failure.

- **powerful valve action . . . no mechanical linkages to cause trouble.**
- **small and lightweight . . . easy to pipe and support.**
- **each unit steam-tested before shipment.**

So, to get a trap that discharges faster, saves money, specify Nicholson. W. H. NICHOLSON AND COMPANY, 14 OREGON ST., WILKES-BARRE, PA. *Sales and Engineering offices in 98 principal cities.*



Write for Bulletin 1055

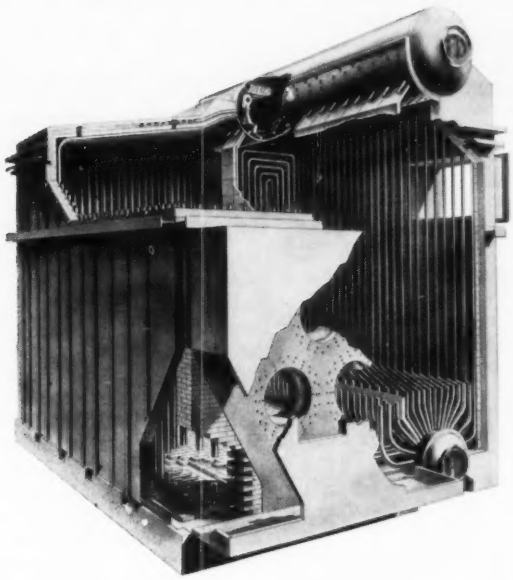
NICHOLSON
of Wilkes-Barre

Here's why you get

IMPORTANT SAVINGS in

- ✔ *first cost*
- ✔ *installation*
- ✔ *operation*
- ✔ *maintenance*

with the FW Series "SC" STANDARD BOILER

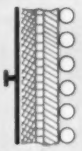


THESE nine Foster Wheeler design features add up to substantial savings in the cost of steam generation. Equally important is the extra *dependability* that's built into every "SC" unit – the result of over 60 years of experience in the design and construction of large, high-pressure steam generators for leading central station power plants.

* Pre-engineered in all details and standardized for economy, these FW standard steam generators are available for oil or gas firing, in capacities from 50,000 to 150,000 lb/hr, for pressures to 1500 psi and superheated steam temperatures to 950 F. For complete information, send for Bulletin B-55-4. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

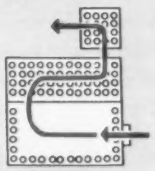
1. COMPLETELY WATER-COOLED WALLS

All furnace walls are cooled by closely-spaced tubes, minimizing setting maintenance and preventing excessive exit gas temperatures.



2. EFFICIENT FIRING ARRANGEMENT

Burner arrangement assures maximum rating without overheating furnace tubes. Rear wall is over 19 ft. from burner wall, permitting long, horizontal flame travel.



3. FULLY DRAINABLE SUPERHEATER

A completely drainable superheater permits removal of all condensed water from the elements before start-up.

4. HIGH STEAM PURITY

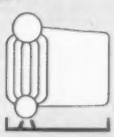
The normal drum internals consist of chevron dryers and a dry box. Separators may be added which make possible a steam purity of 1PPM or less.

5. UNRESTRICTED CIRCULATION

Absence of headers provides free circulation through integral risers and downcomers, eliminating header handhole plates and gaskets.

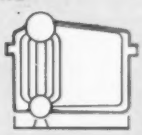
6. BOTTOM SUPPORTED UNIT

The bottom-supported design fully utilizes the structural strength of the tubes and provides low unit stresses in all members.



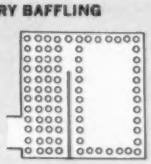
7. PRESSURE-TIGHT CASING

The all-welded casing forms a rigid, pressure-tight unit that can be arranged for pressurized or balanced draft operation.



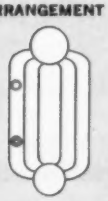
8. MINIMUM REFRACTORY BAFFLING

The wall separating furnace and boiler bank is the only refractory baffling used. It is completely accessible from the furnace.



9. SIMPLE SOOT BLOWER ARRANGEMENT

Soot blowers are supported on the outer row of boiler-bank tubes, simplifying alignment and providing easy access.



FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

Hall Industrial Water Report

VOLUME 5 JUNE 1957 NUMBER 3

Water Causes Trouble Everywhere

We in the United States do not have a corner on problems connected with water. Consequently, Hall Laboratories through the years has become international. Hall staff engineers now assist in the solution of water problems the world over, working with plants from Newfoundland to Chile and from the West Indies to Europe and the Middle East.

Trouble Shooting In Venezuela

When a Venezuelan utility plant fired up a temporarily idle boiler for service, the operators were surprised to find that a number of tubes were leaking. Further inspection revealed that they were badly pitted.

The surprise of the operators was understandable because boiler water analyses during the work week for the previous 18 months had shown adequate concentrations of alkalinity and sodium sulfite for prevention of corrosion. Furthermore, tests showed dissolved oxygen in the feedwater to be zero.

Hall staff engineer J. E. Summerville made a hurried trip to the plant to determine the cause of the trouble. The pitting nature of the corrosion belied the absence of dissolved oxygen from the boiler feedwater and the presence of adequate amounts of sodium sulfite in the boiler water. Hence, his investigation was directed toward finding out how oxygen was getting into the boilers.

The source of oxygen was quickly located. All boilers were shut down each week end. Air could enter the steam drums when steam pressure dropped. Moreover, with no steam available for the deaerator, any water pumped into the boilers was not deaerated. No water testing was done over week ends.

Changes were instituted immediately to avoid pumping undeaerated water into the boilers and to build up high concentrations of sodium sulfite in the boiler water for week ends. The problem which seemed so puzzling was simply diagnosed and solved because of the specialized experience of the Hall Engineer.

Water is your industry's most important raw material. Use it wisely.

Dirty Cooling Towers Impair Efficiency

Scale formation in the oil coolers and heat exchangers of the recirculating cooling system for diesel engines caused frequent outages and inefficient performance of equipment at an electric generating plant in Haiti. Scale had even formed in the cooling towers.

Untreated city water was normally used as makeup for the cooling system. When it was in short supply, however, water from deep wells was substituted. Analyses indicated to Hall staff engineer A. M. Henricks that both waters were scale-forming in character. He recommended that the water be stabilized against deposition of scale by threshold treatment with Calgon,® supplemented with some sulfuric acid to hold alkalinity of the recirculated water at a satisfactory level.

Algae and bacteria growths in the system were prevented by disinfection with calcium hypochlorite.

Again, trouble-free operation was simply accomplished because of the specialized knowledge and experience of the Hall Engineer.

All Not Left to Kismet

Heavy iron oxide deposits in the boilers of a large Middle East oil company caused many tube failures and costly unscheduled outages.

A study of the problem showed the source of the iron oxide to be corrosion in the condensate return system. Since carbon dioxide in the steam was a factor in the corrosion, some consideration was given to decarbonation of evaporator feedwater with sulfuric acid. However, this would have involved a substantial investment for equipment as well as careful chemical control and operation. Hall staff engineer A. M. Henricks accordingly recommended the use of Hagafilm,® which effectively controls corrosion of metal surfaces contacted by condensate even though the condensate contains dissolved carbon dioxide and oxygen.

The Hagafilm feed did all that was asked of it. It stopped the corrosion and cleaned up the system so effectively that the plant reported "deposits in the boilers have been so light during recent inspections that semi-annual inspections have been discontinued."

Cemented Relations

The heading might apply to the harder-than-concrete complex aluminum silicate scale which was causing loss of boiler tubes in a Colombian oil refinery.

Lake water used in the boilers contained a lot of iron. Coagulation with alum followed by ineffective filtration did not remove the iron. Instead, a considerable amount of aluminum from the alum passed through the filters in the water and went to the boilers causing formation of the complex aluminum silicate scale.

A solids-contact clarifier which had been installed to treat water for a recirculating cooling system was not being used. At Hall's recommendation a few mechanical changes were made to adapt the equipment to treatment of the boiler feedwater. This made possible successful clarification and removal of iron from the water without contaminating the effluent with aluminum.

Now, "cemented" applies to relations between Hall Laboratories and the plant rather than to the scale in the boilers.

Industrial Water Problems Require Special Handling

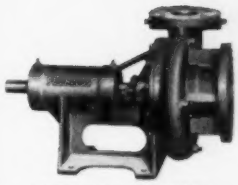
There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Division of Hagan Chemicals & Controls, Inc., Hagan Building, Pittsburgh 30, Pa.

Hall Laboratories—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

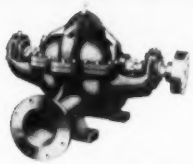
How to Save

TIME \ MONEY \ ENERGY \

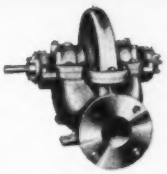
TYPE PE FLUIDYNE INTEGRAL HP PUMPS
A complete line of electric close-coupled general purpose pumps. Threaded or flanged connections. Capacities: to 800 gpm; heads: up to 260 feet; motors: up to 50 h.p.



TYPE PB FLUIDYNE GENERAL PURPOSE PUMPS
Flexible coupled, single-stage, end suction, general purpose pumps. Rugged and durable. Capacities: up to 5500 gpm; heads: up to 260 feet; motor: up to 150 h.p.

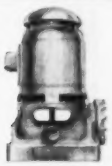


TYPE A GENERAL PURPOSE PUMPS
For application to the widest variety of pumping conditions. Single stage split case design. Capacities: up to 70,000 gpm; heads: to 300 feet. All types of drive.

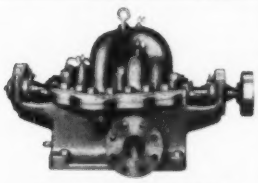


TYPE AS GENERAL PURPOSE PUMP
The centrifugal pump with mechanical shaft seals that eliminate the packing box. Up to 4" in discharge sizes. Capacities: up to 750 gpm; heads up to 210 feet.

BY BUYING FROM THE COMPLETE LINE

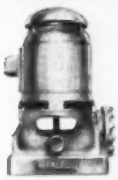


VERTICAL DEEP WELL TURBINE PUMPS
For application to deep well pumping. Lifts from 1000 feet or more. Capacities: up to 30,000 gpm. H.P. range: up to 1000 h.p. oil and water lubricated types. Widest range of sizes.



TYPE TU BOILER FEED AND PROCESS PUMP
2-stage high pressure pump for water and other liquids. Capacity: 50 to 3500 gpm; heads: up to 600 feet. Internal cross over is built into top half of pump case.

TYPE TUT MULTI-STAGE PUMPS
3, 4 and 5-stage pumps for water handling and process services. 1" to 5" discharge sizes. Capacity: up to 1350 gpm; head range: up to 1600 feet. Split case design.



INDUSTRIAL SERVICE PUMPS
For application to pits, sumps, basins, reservoirs and other surface water sources. Same capacity as deep well turbine above. H.P. range: up to 2500 h.p.

HYDRO-LINE PUMPS
An enclosed, close-coupled, vertical centrifugal process pump for handling petroleum hydrocarbons, where NPSH is limited. Capacities: to 6000 gpm; heads: to 1500 feet.

HI-LIFT PUMPS
The unique positive displacement deep well pump that literally squeezes water upward. Capacity: 10 to 55 gpm; lifts: up to 1000 feet. For wells 4" in diam. and up.

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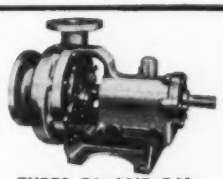

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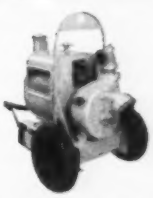

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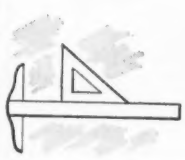

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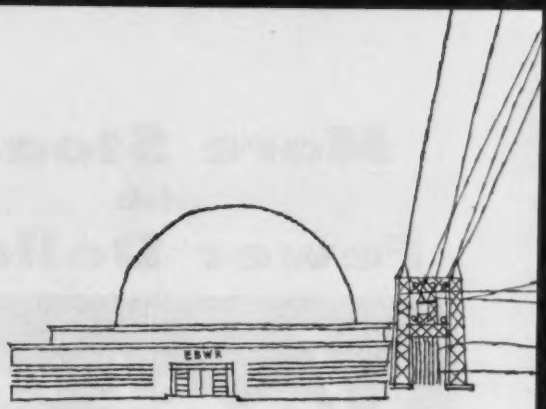

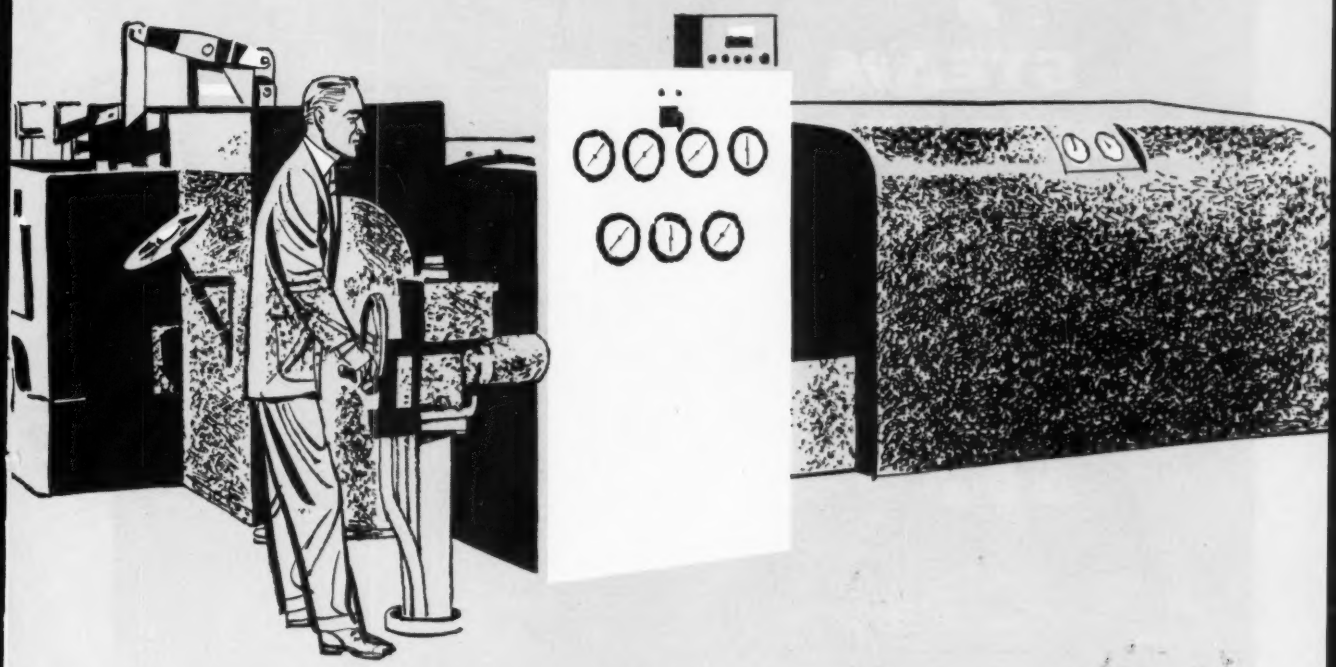

Last December at Argonne National Laboratory, Lemont, Illinois, the Experimental Boiling Water Reactor achieved its design power level of 5,000 kw. for the first time. The lubricating oil in the Allis-Chalmers turbine was Standard's NONPAREIL Turbine Oil.

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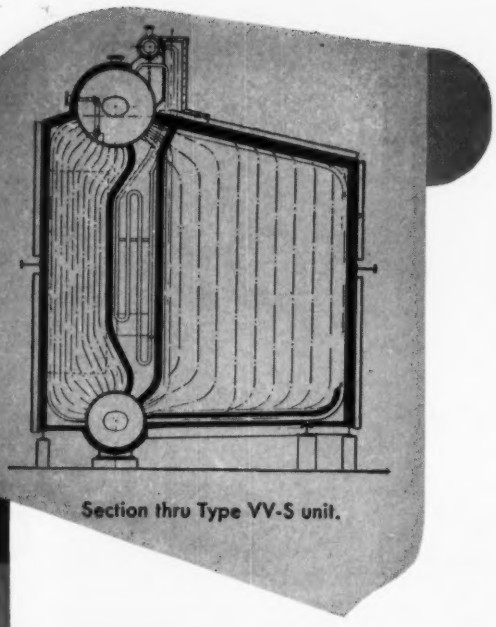
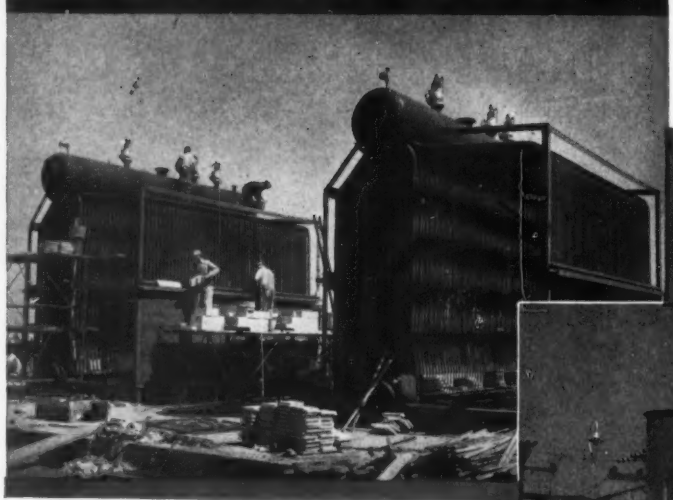


Section thru Type VV-S unit.



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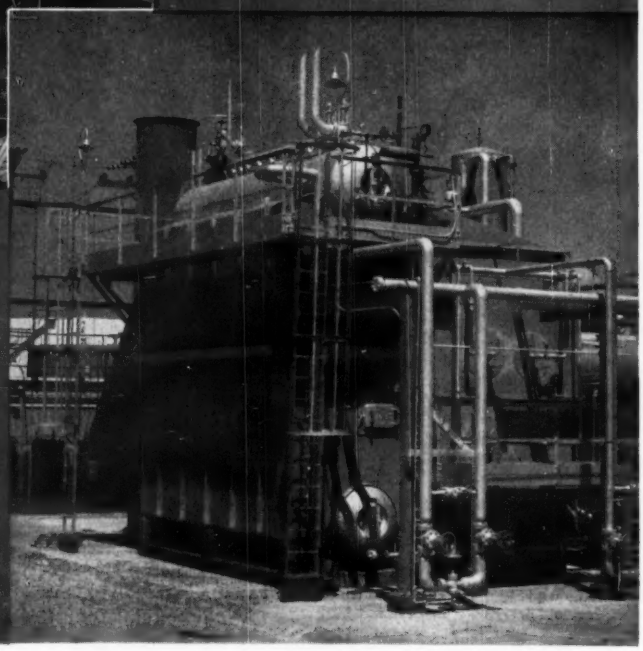

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LOUIS N ROWLEY, EDITOR • JUNE 1957 • ESTABLISHED 1882 Power

What makes an idea pay off?

THAT was the question that came to mind recently, as I was checking some old volumes of POWER in preparation for the 75th Anniversary coming up in September. There, back in the 1880's, I ran across examples of two developments anyone would unhesitatingly label as modern.

One, in December 1887, reported that a German manufacturer had constructed an all-welded boiler. The other, in June 1888, described a high-temperature hot-water system for district heating. With such an early start, why did these clearly sound ideas take so long to come into wide use?

It seems to me there are two big factors that make all the difference. To win wide acceptance, a new engineering idea must meet a demonstrated need. And the technical means must be available to bring it to commercial realization.

The case of the rivetless boiler illustrates both, I believe. For the conditions of the time, riveted joints were relatively satisfactory. The common boiler type of those days was the firetube. Pressures were low—rarely over 100 psi. Most units were small. There just was no crying need for any radical departure from riveted construction.

Perhaps even more important, the technology wasn't sufficiently advanced to make a welded boiler practical. Electric welding didn't come into use until the 1890's, so this German unit must have been gas welded. Relatively little was known about metallurgy in those days, and the materials from which pressure vessels were fabricated varied widely in composition and physical properties.

Under these conditions, producing consistently sound welds must have been virtually impossible. Although POWER quoted the German manufacturer as saying cost was only slightly in excess of that for riveted construction, the chances are that he would have found costs considerably higher if regular production had been attempted. So, for a variety of reasons, the basic idea lay dormant for many years.

But the time came when advances in pressure and temperature, changes in boiler design and demand for large units made welded construction not only desirable but necessary. With the need came the technical means: highly developed welding equipment, superior materials with which to work, a firm knowledge of the metallurgy of steels, radiography and other inspection methods by which weld quality could be verified.

All through engineering history we find examples, like this one, of ideas that were born too soon and seemed doomed to obscurity. But—and this is the important and encouraging point—time after time, when a real need developed, the means to meet it were discovered. It is the repeated appearance of this pattern throughout the past 75 years of power-field history that give me supreme confidence in our ability to meet the ever greater technical challenges ahead.

"On a low voltage situation, Fusetron dual-element Fuses opened and warned us of the need for a larger transformer"

HERMAN BOND, PRES.
ACME ELECTRIC CO., DENVER, COLO.

Here's Mr. Bond's own story of how Fusetron fuses helped solve the low voltage situation.

"A flock of Fusetron dual-element fuses blew one afternoon at the Duffy Bottling Works several weeks after we had completed changing the entire plant to this type of fuse in an effort to eliminate extreme heating in switches and to get more dependable protection.

"Before putting the circuits back in operation we wanted to find out what had caused the Fusetron fuses to open.

"On checking, we learned that a severe voltage drop occurred whenever the plant was in full operation. The trouble was due to the transformer being too small to keep the voltage at its normal value of 220 volts.

"To prevent the trouble recurring, a larger transformer was installed. Since then, they have had no more low voltage difficulty.

"By opening and warning of the need for a larger transformer, Fusetron fuses not only saved Duffy Bottling Works the expense of possible motor burnout, but also prevented costly slowdowns in their production."

You too, can save money throughout the plant by using Fusetron fuses . . . ***They Provide 10 Point Protection*** **1.** High interrupting capacity —protect against short circuits. Have proven on tests to open safely on circuits set to deliver in excess of 100,000 amperes. **2.** Protect against needless blows caused by excessive heating—lesser resistance results in cooler operation. **3.** Protect against needless blows caused by harmless overloads. **4.** Provide thermal protection—for panels and switches against damage from heating due to poor contact. **5.** Protect against waste of space and money—permit use of proper size switches and panels. **6.** Protect motors against burnout from overloads. **7.** Give DOUBLE burnout protection to large motors—without extra cost. **8.** Protect motors against burnout due to single phasing. **9.** Make protection of small motors simple and inexpensive. **10.** Protect coils, transformers and solenoids against burnout.

DON'T RISK LOSSES! One lost motor . . . one needless shutdown . . . one destroyed switch or panel . . . one burned out solenoid . . . may cost you far more than replacing every ordinary fuse with Fusetron dual-element Fuses. *Write for Bulletin FIS.*

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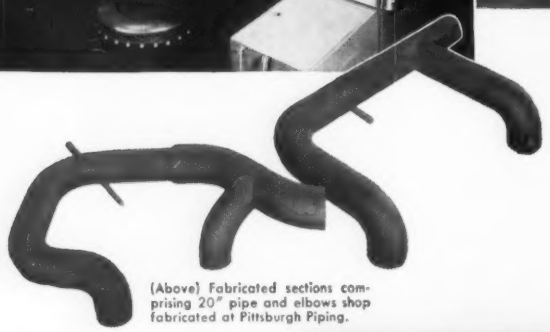
another P. P. & E. service which contributes to *Improved* HIGH-TEMPERATURE HIGH-PRESSURE PIPING

(Below) Metallographic examination of piping materials and weld samples reveals changes which occur in a metal's crystalline structure due to operating conditions and fabricating procedures.



(Above) Fabricated sections comprising 20" pipe and elbows shop fabricated at Pittsburgh Piping.

Our technical staff constantly explores the mechanical and metallurgical aspects of power and process piping. For example, stress analysis by model testing is used to predict accurately the physical reactions of high-temperature, high-pressure piping in service. Extensive investigations are conducted on the metallurgical effects of operating conditions and fabricating procedures on piping materials. This knowledge pays off in the sound piping systems we fabricate and erect for central stations and nuclear power installations.

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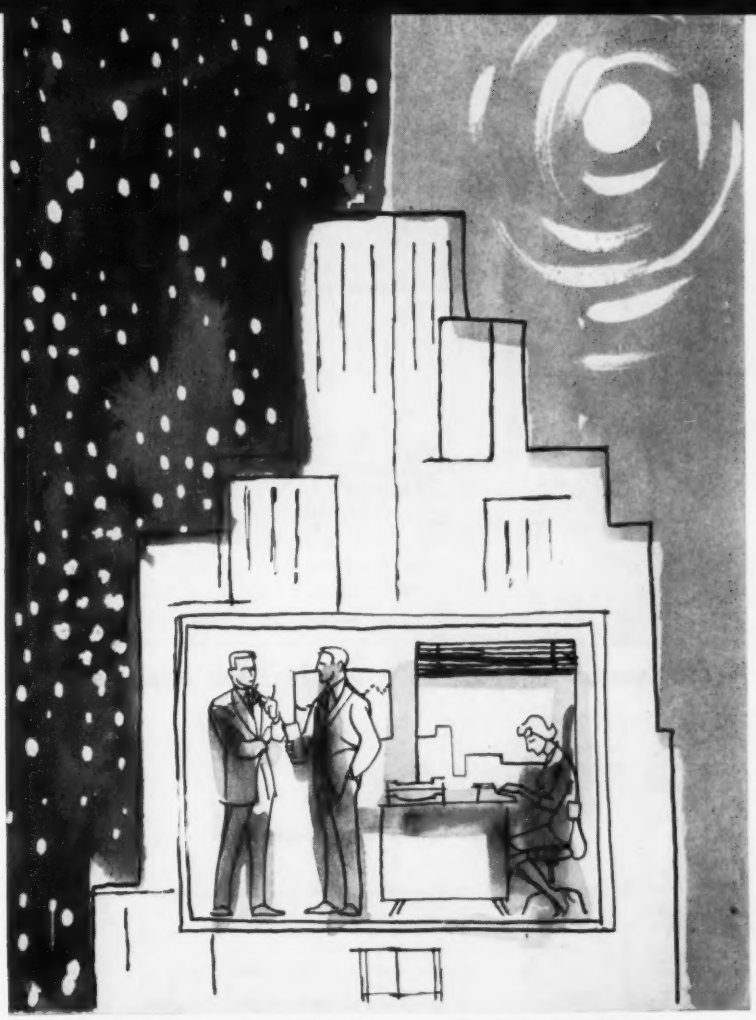


For winter heating... summer cooling...

Heat pumps bid for colder-climate jobs

By J R HARNISH
Application Engineer
York Corporation
Div of Borg-Warner Corp

► THE HEAT PUMP—a species whose natural habitat was once confined to the Mason-Dixon line and points south—is moving north. In fact, north or south, you may be considering one for year-around heating-cooling of your plant, commercial building or home sooner than you think. Here's why:

The electrical power picture is becoming more favorable. Gap between the unit cost of electricity and fossil fuels is gradually narrowing down. Utility companies, aware of the heat pump's great potential as a market for their product and as a means of leveling out their annual load curves, will encourage heat pump use on a greater scale.

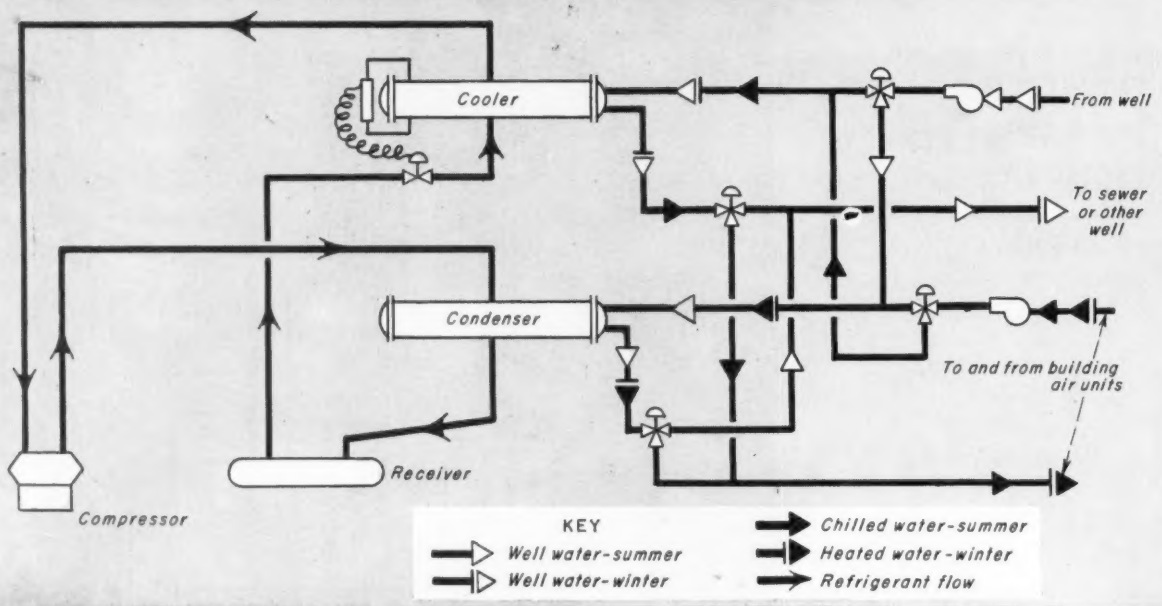
We are fast becoming air-conditioning conscious. Thus, once the decision has been made to go to air conditioning, the refrigeration plant is available in any case. With a few modifications it can be designed to act as a heat pump and provide winter heating too.

Our fossil fuel supply is limited. It may soon become uneconomical to use 40% of the world's fuel supply for space heating.

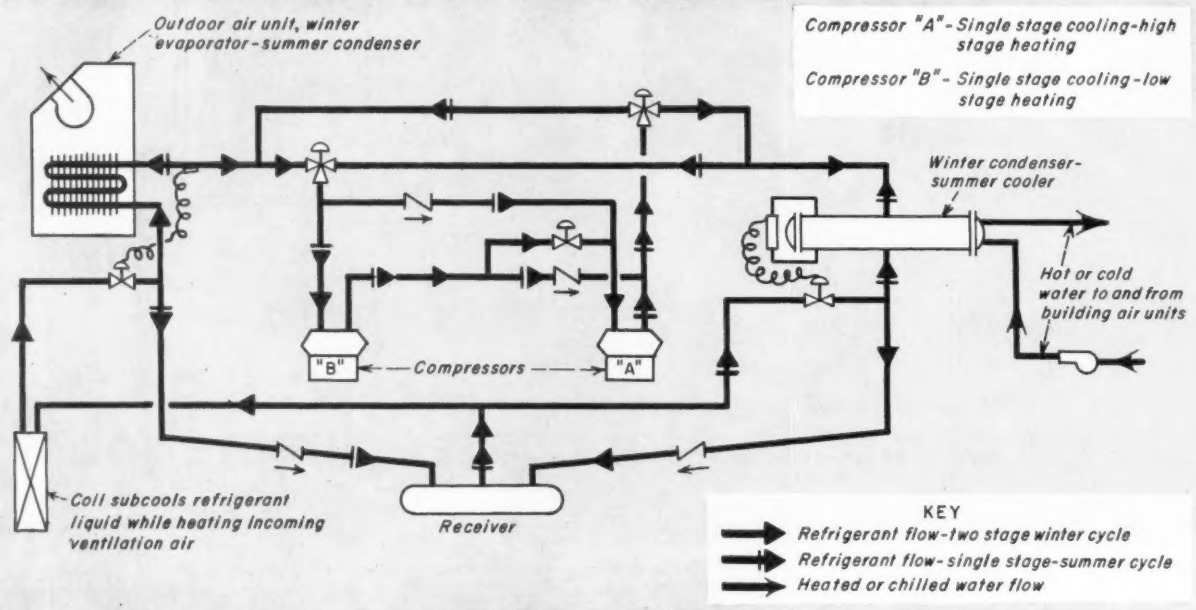
New advances in technology make the heat pump more flexible, reliable.

Recent installations in commercial buildings in Philadelphia, Pa., Minneapolis, Minn., Tacoma, Wash., point to fewer geographical limits on their use.

Now let's take a look at heat pump basics, see what they hold for the future. The heat pump—often called a reverse-cycle refrigeration system—removes heat from a space during the



Water-source heat pump is efficient but good sources are getting harder to find...


Outdoor air unit, winter evaporator-summer condenser
Compressor "A"-Single stage cooling-high stage heating
Compressor "B"-Single stage cooling-low stage heating
Winter condenser-summer cooler
Hot or cold water to and from building air units
"B"
Compressors
"A"
Coil subcools refrigerant liquid while heating incoming ventilation air
Receiver
KEY
Refrigerant flow-two stage winter cycle
Refrigerant flow-single stage-summer cycle
Heated or chilled water flow

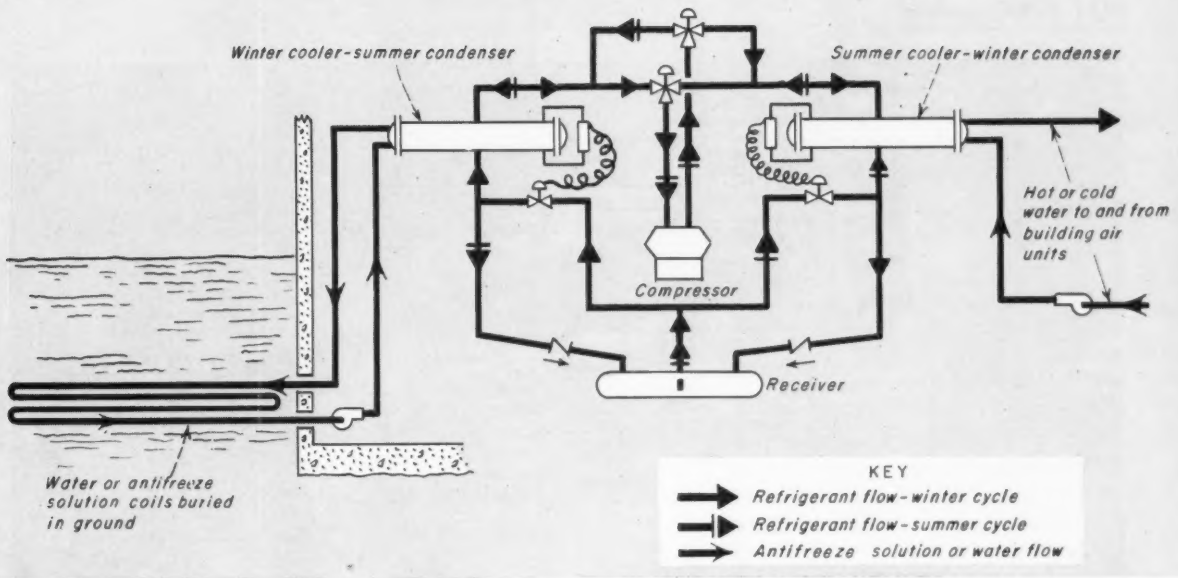
Air-source designs tap an abundant supply, minimum air temp sets economic limit

summer, discharges it to an external heat sink. For winter heating, the pump removes heat from an external source, delivers it to the space. The electric refrigerator, although not reversible, is really a heat pump. The evaporator (at low temperature) absorbs heat from stored food plus heat leakage from the kitchen to the refrigerator. Refrigerant evaporator pressure (and as a result, temperature) is boosted by the compressor. The condenser then removes heat from the refrigerant by blowing slightly cooler air over refrigerant coils. Thus the refrigerator removes heat from a lower temperature, elevates it to a higher one.

Key to understanding the heat pump: Any substance at a temperature above –459.7 F, contains *some* heat. Problem is to remove heat from a low-temperature substance, elevate it to a usable temperature level.

Basically, the heat pump can tap three practical heat sources: water, air and the ground. Water is the most desirable since heat can be removed from it at relatively high temperature, always above the freezing point. As available source temperature level goes up, efficiency rises with it.

Let's compare the heat pump to a water pump. The greater the *pressure* difference across the water pump, the higher the horsepower input requirement. With the heat pump, the greater the *temperature* difference between evaporator and condenser, the larger the power input to the compressor.



Ground-source units need extensive coils, changing soils affect heat transfer...

WATER SOURCE

Limitation on the water source is the fact that it's not universally available. And, in many populated sections of the country, it's becoming increasingly scarce. Well water is the most common water source because its temperature won't fluctuate much throughout the year. Lakes and rivers also offer a supply in areas where expected water temperature doesn't approach the freezing point.

In applying a water-source heat pump you'll need to weigh these factors: (1) Is there a continuous supply of water at required flow rates? (2) Is water temperature relatively constant throughout the heating season? (3) Can used water be disposed of? (4) How much power is needed to pump the water source (friction head, static head)?

Drawing, top of p 74, shows a typical water-source heat pump. We don't generally reverse the refrigeration system in going from heating to cooling. Common setup passes well water through the condenser during summer and through the cooler during heating season. We pump chilled or heated water through the other shell to provide water at the right temperature to the building air-handling equipment.

If sea or brackish water is the available heat sink, refrigerant flow is generally reversed in going from cooling to heating. Such an arrangement keeps building (conditioned) water from becoming contaminated. Alternate scheme: Locate a separate closed heat exchanger between the salt water and another water circuit going to the refrigeration system. Then reverse water flow, without danger of contamination.

On smaller buildings using a single air-handling plenum, we can heat or cool conditioned air directly with an evaporator-condenser coil (direct expansion) located in the air stream. But the refrigeration system must be reversible.

GROUND SOURCE

For ground-source heat pumps we embed coils beneath the earth at some point below the frost line. Since the ground isn't subject to the severe air temperature changes, it is a heat source. During the summer cycle we reject condenser heat from the building to the ground.

Drawbacks of the ground source are (1) high first cost caused by extensive ground coils (2) soil conditions change, affecting heat transfer rates (3) lack of sufficient ground area to locate large coils—especially in urban areas.

Drawing, above, is a typical ground-source heat pump. Water or an antifreeze solution circulates through the ground coils and the summer condenser-winter cooler. Conditioned water circulates from the summer cooler-winter condenser to the building air-handling units. Thus, refrigeration system itself is reversible.

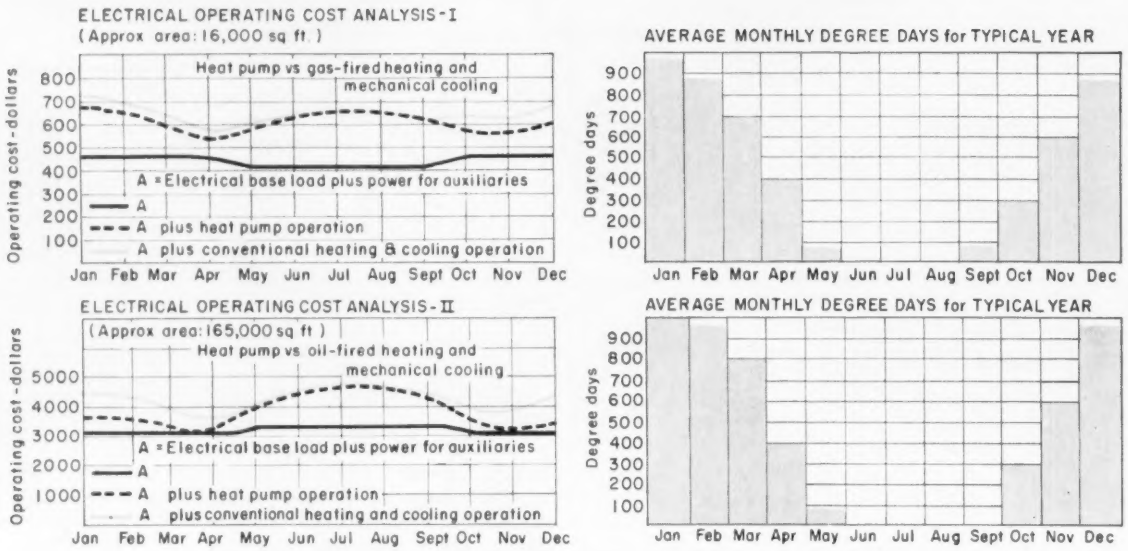
In milder climates the refrigeration system can be nonreversible. Then water reverses flow through the heat exchangers.

On smaller systems an evaporator-condenser coil in the air stream can heat or cool the building air directly. Here the refrigeration circuit must be reversible. Still another arrangement circulates refrigerant directly in the ground coils. But the large amounts of refrigerant necessary, possibility of costly leaks and condenser drainage pose limitations.

AIR SOURCE

The air-source heat pump has an obvious advantage: Air is abundantly available. Its only possible limitation is economical minimum air temperature; –20-F outside air-design temperature is a practical minimum today. In future years many favorable factors point toward an even lower figure.

Until recently 20 F represented a lower limit for the air-source heat pump because operating efficiency dipped substantially at lower temperatures. But a recent heat pump development — compounding compressors— yields good operating efficiency even where outside-air temperatures are low. Instead of going to high-compression ratios and high-pressure differentials, we operate two compressors in series, reducing the compression ratio across each machine. Thus the system operates more efficiently, both from the displacement and power requirement viewpoints. (*Continued on page 76*)



Operating costs for typical Middle-Atlantic area installations

Curves compare electrical operating costs of the heat pump with conventional (oil- or gas-fired) heating and summer air conditioning. Top graph is for a relatively small building. Lower graph is for a large building. Average number of degree days on which each cost comparison was made is shown to right of the graphs. Conditions are typical for Middle-Atlantic areas.

Note: Heat pump electrical costs are superimposed on electrical base load. It benefits from favorable electrical rates because of increased power needs. In both cases, heat pump shows savings.

Important point: Operating costs of an air-source heat pump compared to a conventional heating system, can't be based on lowest outside air temperature alone. True, the heat pump is least efficient at this lowest temperature. But chances are it will operate only a few hours during the winter season at this figure. To get a true picture, compare expected hours of operation at various temperature levels.

Lower drawing, p 74, shows an air-source heat pump with compound compression and liquid refrigerant being subcooled by the incoming ventilation air. During the winter cycle we remove heat from the outside air, elevate it to a higher temperature and use it to heat the condenser water that circulates throughout the building. During the cooling season we reject the heat absorbed by the circulating water to the outside air via the outdoor-air unit. The air unit can be a dry coil. Or, to boost system efficiency, an evaporative-condenser coil may be used.

On mild winter days we can short circuit a compressor, operate the system single stage. As temperature drops below single-stage-compressor capacity, the low-stage compressor automatically cuts in. Depending on the ratio of summer to winter load, the low-stage compressor may be arranged to operate in parallel with the other compressor during the cooling season.

Liquid refrigerant is subcooled to improve system efficiency. We could also use an intercooler in place of the subcooler.

Some variations of the compound air-source heat pump are (1) single-stage heating in milder climates (2) supplementary electric heating in colder climates (3) direct heating-cooling of conditioned air by an evaporator-condenser coil in the air stream.

How does the heat pump size up against conventional summer air conditioning plus winter heating with gas, oil or coal? In an ever-increasing number of cases, the heat pump can successfully compete with the yearly operating costs of heating with fossil fuels. Here's why: If a building is installing air conditioning, why not use the refrigeration plant to heat the building during the winter? The added investment cost of controls and miscellaneous equipment to do the job is small compared to the cost of a separate heating system.

How about operating costs? In sizing up the heat pump with a conventional heating system, fuel rates vs electrical rates don't tell the whole story. In most larger installations the electrical energy demand for lights, motors, appliances, elevators, etc is already substantial. Since these base costs must be paid for in any case, heat-pump electrical costs can be figured at a preferred rate that may result from increased electrical use.

Trend: In the past, electrical rates have been fairly constant while the price of fossil fuels continue to move up. And as fossil fuels become increasingly scarce over the years, their recovery will be even more expensive. Thus, the gap between electrical and fuel costs will continue to narrow.

Space-saving advantages of the heat pump can also be important. Its space needs aren't appreciably greater than for the air-conditioning system alone. And fuel-storage problems drop out of the picture. Only energy supply is the incoming power line.

(*Continued on page* 230)

What will good lighting cost you?

By DON PHILLIPS and DICK WOODS, *General Electric Co*

► ADVANTAGES OF A GOOD industrial lighting system are getting to be well known. Plants which have invested in adequate lighting have found it pays off in increased worker efficiency and a lower accident rate. Tables on following pages help you to (1) find what it will cost to give your plant good lighting (2) pick the system best suited to your needs. What's a good lighting system, and how to design it, is described in POWER'S *Industrial Lighting* special report, June 1956.

Table 1, p 78, covers low-mounted fluorescent lighting systems. Table 2 covers high-mounted mercury, incandescent and fluorescent lighting. Costs given are typical and will serve for a preliminary estimate. When you think you've found the lighting system you want, substitute actual cost of items in your area and get a close estimate of what your lighting costs will be. Incandescent lamp designations (R-52, PS-52) and fluorescent designations are standard with all manufacturers. Mercury lamp numbers (those beginning with H) vary somewhat with manufacturer, but are easily identifiable. Tables are based on procedure outlined in IES paper, *Fundamentals of Lighting Cost Analysis* by Barr and Amick, published in *Illuminating Engineering*, May, 1952.

Mercury-incandescent systems, combining any of systems represented in Table 2, can be estimated as follows:

Multiply relative cost figures given in Table 2 for each component lighting system by percentage of light that each system contributes to total output of combination system. Procedure applies to initial, annual operating and total annual costs, and also to relative number of luminaires needed for equal maintained foot-candles.

Example: Assume a combination system of two H400-R1 mercury lamps (Column VI) to every one 750R-52 (Column II) incandescent lamp. Find relative cost compared to base system (Column I).

Solution: The two H400-R1 lamps produce 16,780 effective maintained lumens (Item 7, Col VI). One 750R-52 produces 7000 effective maintained lumens (Item 7, Col II). Total lumens produced = 16,780 + 7000 = 23,780, made up of 71% from the H400-R1 lamps and 29% from the 750R-52. Apply these percentages multiplying factors to the relative cost values given for each of the two component systems. The relative weighted values are then added to get relative cost values for the combination, like this:

Relative initial cost (Item 14)

Two H400-R1	1.19 × 0.71 =	0.85
One 750R-52	1.09 × 0.29 =	0.32
Combination		1.17

Relative annual operating cost for 2500 hr, 1c per kwhr (Item 22)

Two H400-R1	0.57 × 0.71 =	0.40
One 750R-52	0.92 × 0.29 =	0.27
Combination		0.67

Relative total annual cost for 2500 hr, 1c per kwhr (Item 24)

Two H400-R1	0.71 × 0.71 =	0.50
One 750R-52	0.94 × 0.29 =	0.27
Combination		0.77

Table I—Cost analysis: industrial fluorescent

		I Slimline instant start 120-volt 8-ft section 2—96T12 (series)		II Slimline instant start 120-volt 8-ft section 2—96T12 (lead-lag)		III Slimline instant start 277-volt 8-ft section 2—96T12 (series)	
BASIC DATA							
1. Rated initial lamp lumens per luminaire (standard cool white)		10,1000		10,100		10,100	
2. Lamp life, hours		7500		7500		7500	
3. Average watts per lamp		74		74		74	
4. Watts per luminaire (includes ballast watts)		174		182		178	
5. Coefficient of utilization (a)		.74		.74		.74	
6. Maintenance factor (b)		.80		.80		.80	
7. Effective maintained lumens per luminaire (Items 1 x 5 x 6)		5980		5980		5980	
8. Relative number of luminaires needed for equal maintained ft-c		1.00		1.00		1.00	
INITIAL COSTS							
9. Net cost of one luminaire (estimated)		$44.00		$48.40		$45.60	
10. Installation and distribution system cost per luminaire (estimated)		$34.00		$34.00		28.50	
11. Net initial lamp cost per luminaire including tax (estimated) (c)		$ 4.30		$ 4.30		$ 4.30	
12. Total initial cost per luminaire (Items 9+10+11)		$82.30		$86.70		$78.40	
13. Annual owning cost per luminaire (15% of Items 9+10) (d)		$11.70		$12.35		$11.10	
14. Relative initial cost for equal maintained foot-candles (Items 12 x 8) for system compared / Item 12 for base system		1.00		1.05		.95	
ANNUAL OPERATING COSTS							
15. Burning hours per year		2500	4000	2500	4000	2500	4000
16. Annual energy cost	1¢ per kwhr	$ 4.35	$ 7.00	$ 4.55	$ 7.30	$ 4.45	$ 7.10
(Items 4 x 15 x rate in ¢ per kwhr) / 100,000	2¢ per kwhr	$ 8.70	$14.00	$ 9.10	$14.60	$ 8.90	$14.20
17. Number of lamps replaced per year (Item 15 x no. lamps per unit) / Item 2		.67	1.07	.67	1.07	.67	1.07
18. Lamp cost (Item 17 x net price per lamp including tax)		$ 1.45	$ 2.30	$ 1.45	$ 2.30	$ 1.45	$ 2.30
19. Labor cost for lamp replacements (e)		$ .65	$ 1.05	$ .65	$ 1.05	$ .65	$ 1.05
20. Cost of cleaning twice per year		$ 1.70	$1.70	$ 1.70	$ 1.70	$ 1.70	$ 1.70
21. Total annual operating cost per luminaire	1¢ per kwhr	$ 8.15	$12.05	$ 8.35	$12.35	$ 8.25	$12.15
(Items 16+18+19+20)	2¢ per kwhr	$12.15	$19.05	$12.90	$19.65	$12.70	$19.25
22. Relative annual operating cost for equal maintained foot-candles	1¢ per kwhr	1.00	1.00	1.02	1.02	1.21	1.01
(Items 21 x 8) for system compared / Item 21 for base system	2¢ per kwhr	1.00	1.00	1.03	1.03	1.22	1.01
TOTAL ANNUAL COST							
23. Total annual cost per luminaire (Items 13+21)	1¢ per kwhr	$19.85	$23.75	$20.70	$24.70	$19.35	$23.25
	2¢ per kwhr	$24.20	$30.75	$25.25	$32.00	$23.80	$30.35
24. Relative total annual cost for equal maintained ft-c (Item 23) x (Item 8) for system compared / (Item 23) for base system	1¢ per kwhr	1.00	1.00	1.04	1.04	.97	.98
	2¢ per kwhr	1.00	1.00	1.04	1.04	.98	.99
Visual comfort index (f) (g) (h)		78		78		78	

Luminaires: open-top, porcelain-enamel industrial reflectors

(a) For room ratio, 5.0 (A), 70% ceiling, 30% walls. Calculated by Potter-Russell flux-ratio method

(b) Includes mean lamp depreciation and mean dirt depreciation during life, with two cleanings per year

(c) Initial lamp cost contributes to total initial cost per luminaire (Item 12), but not to annual owning cost per luminaire (Item 13). The annual cost of lamps is an operating cost, not an owning cost

(d) Ten-year write-off at 10% per year, plus 5% for interest, insurance, and taxes

(e) Assumed: $1.20 per lamp if starters are required; $1.00 per lamp if not

(f) Per cent of people who would be expected to appraise the lighting system as comfortable when seated at the middle of the rear wall looking horizontally — crosswise view of lighting fixtures

lighting systems for low mounting

IV High-output rapid start 120-volt 8-ft section 2—96T12/HO	V 40-watt Preheat start 120-volt 8-ft section 4—40-watt T12	VI 40-watt rapid start 120-volt 8-ft section 4—40-watt T12/RS	VII 90-watt preheat start 120-volt 10-ft section 4—90-watt T17	VIII(j) 90-watt sequence start 277-volt 10-ft section 4—90-watt T17
14,600	10,000	10,000	20,600	20,600
7500	7500	7500	7500	7500
105	39	39	90	90
264	192	188	422	396
.73	.74	.74	.72	.72
.76	.79	.80	.74	.74
8100	5850	5920	10,980	10,980
.739	1.025	1.010	.546	.546
$52.10	$45.50	$45.50	$63.50	$51.00
$40.30	$39.00	$39.00	$64.50	$62.00
$ 5.00	$ 3.10	$ 3.40	$ 7.55	$ 7.55
$97.40	$87.60	$87.90	$135.55	121.05
$13.85	$12.70	$12.70	$ 19.20	$ 17.05
.87	1.09	1.08	.90	.80

2500	4000	2500	4000	2500	4000	2500	4000	2500	4000
$ 6.60	$10.55	$ 4.80	$ 7.70	$ 4.70	$ 7.50	$10.55	$16.90	$ 9.90	$15.85
$13.20	$21.10	$ 9.60	$15.40	$ 9.40	$15.00	$21.10	$33.80	$19.80	$31.70
.67	1.07	1.33	2.14	1.33	2.14	1.33	2.14	1.33	2.14
$ 1.65	$ 2.70	$ 1.05	$ 1.65	$ 1.15	$ 1.80	$ 2.50	$ 4.05	$ 2.50	$ 4.05
$ .65	$ 1.05	$ 1.60(i)	$ 2.55(i)	$ 1.35	$ 2.15	$ 1.60(i)	$ 2.55(i)	$ 1.60(i)	$ 2.55(i)
$ 1.70	$ 1.70	$ 1.70	$ 1.70	$ 1.70	$ 1.70	$ 2.00	$ 2.00	$ 2.00	$ 2.00
$10.60	$16.00	$ 9.15	$13.60	$ 8.90	$13.10	$16.65	$25.50	$16.00	$24.45
$17.20	$26.55	$13.95	$21.30	$13.60	$20.65	$27.20	$42.40	$25.90	$40.30
.96	.98	1.15	1.16	1.10	1.10	1.11	1.16	1.07	1.11
1.02	1.03	1.14	1.15	1.10	1.09	1.19	1.21	1.13	1.15
$24.45	$29.85	$21.85	$26.30	$21.60	$25.80	$35.85	$44.70	$33.05	$41.50
$31.05	$40.40	$26.65	$34.00	$26.30	$33.35	$46.40	$61.60	$42.95	$57.40
.89	.90	1.13	1.13	1.10	1.10	.99	1.03	.91	.95
.92	.93	1.13	1.13	1.10	1.10	1.05	1.09	.97	1.02
65		78		78		75 (estimated)		75 (estimated)	

(g) Initial appraisal for a 50-foot-candle installation maintained in a space 120 x 160 ft with luminaires at 14-ft mounting height

(h) For additional information see "Visual comfort index data and tables" by Meaker and Oetting

(i) Includes cost of starter replacements

(j) This system is more complex than conventional two-lamp systems; therefore, maintenance is more difficult

Table II — Cost analysis: industrial

Lighting systems →	I 1—1000-watt PS-52 120 volts		II 1—750-watt R-52 120 volts		III 2—H400-A1 240 volts		IV 2—H400-E1 240 volts	
BASIC DATA								
1. Rated initial lamp lumens per luminaire	23,000		12,700		31,000		42,000	
2. Lamp life, hours	1000		2000		6000		6000	
3. Average watts per lamp	1000		750		400		400	
4. Watts per luminaire (includes ballast watts)	1000		750		860		860	
5. Coefficient of utilization (a)	.52		.69		.51		.52	
6. Maintenance factor (b)	.76		.80		.73		.65	
7. Effective maintained lumens per luminaire (Items 1 x 5 x 6)	9090		7000		11,540		14,200	
8. Relative number of luminaires needed for equal maintained ft-c	1.00		1.30		.788		.640	
INITIAL COSTS								
9. Net cost of one luminaire (estimated)	$ 6.55		$ 5.00		$ 59.20		$ 59.20	
10. Installation and distribution system cost per luminaire (estimated)	$ 94.80		$78.50		$119.70		$120.30	
11. Net initial lamp cost per luminaire including tax (estimated) (c)	$ 1.45		$ 3.20		$ 18.85		$ 26.00	
12. Total initial cost per luminaire (Items 9+10+11)	$103.30		$86.70		$197.75		$205.50	
13. Annual owning cost per luminaire (15% of Items 9+10) (d)	$ 15.20		$12.55		$ 26.85		$ 26.95	
14. Relative initial cost for equal maintained foot-candles: (Items 12 x 8) for system compared / Item 12 for base system	1.00		1.09		1.51		1.27	
ANNUAL OPERATING COSTS								
15. Burning hours per year	2500	4000	2500	4000	2500	4000	2500	4000
16. Annual energy cost	1¢ per kwhr	$25.00	$40.00	$18.75	$30.00	$21.50	$34.40	$21.50	$34.40
(Items 4 x 15 x rate in ¢ per kwhr) / 100,000	2¢ per kwhr	$50.00	$80.00	$37.50	$60.00	$43.00	$68.80	$43.00	$68.80
17. Number of lamps replaced per year (Item 15 x no. lamps per unit) / Item 2		2.5	4.0	1.25	2.0	.83	1.33	.83	1.33
18. Lamp cost (Item 17 x net price per lamp including tax)		$ 4.90	$ 7.80	$ 4.00	$ 6.40	$ 7.80	$12.50	$10.80	$17.30
19. Labor cost of lamp replacement (e)		$ 3.90	$ 6.20	$ 1.95	$ 3.10	$ 1.30	$ 2.05	$ 1.30	$ 2.05
20. Cost of cleaning twice per year		$ 1.20	$ 1.20	—	—	$ 1.70	$ 1.70	$ 1.70	$ 1.70
21. Total annual operating cost per luminaire	1¢ per kwhr	$35.00	$55.20	$24.70	$39.50	$32.30	$50.65	$35.30	$55.45
(Items 16+18+19+20)	2¢ per kwhr	$60.00	$95.90	$43.45	$69.50	$53.80	$85.05	$56.80	$89.85
22. Relative annual operating cost for equal maintained foot-candles									
(Items 21 x 8) for system compared / Item 21 for base system	1¢ per kwhr	1.00	1.00	.92	.93	.73	.72	.64	.64
	2¢ per kwhr	1.00	1.00	.94	.95	.71	.70	.61	.60
TOTAL ANNUAL COST									
	1¢ per kwhr	$50.20	$ 70.40	$37.25	$52.05	$59.15	$ 79.50	$62.25	$ 82.40
23. Total annual cost per luminaire (Items 13+21)	2¢ per kwhr	$75.20	$110.40	$56.00	$82.05	$80.65	$119.90	$83.75	$116.80
24. Relative total annual cost for equal maintained ft-c	1¢ per kwhr	1.00	1.00	.99	.96	.93	.87	.79	.75
(Item 23) x (Item 8) for system compared / (Item 23) for base system	2¢ per kwhr	1.00	1.00	.97	.97	.84	.80	.71	.68
VISUAL COMFORT INDEX (f) (g) (h)		(i)		(i)		(i)		(i)	

Luminaires

Systems I, III, IV, V, VI, VII: heavy-duty ventilated porcelain-enamel industrial reflectors

II: Protective shield

VIII, IX, X: open-top, wall-shielded aluminum reflector

XI: Alzak aluminum reflector

XII, XIII: open-top porcelain-enamel industrial reflectors; standard cool white lamps

Tulamp ballasts are assumed for all mercury systems except XI

(a) For room ratio, 1.25 (G), 50% ceiling, 30% walls. Calculated by Potter-Russell flux-ratio method

(b) Includes mean lamp depreciation and mean dirt depreciation during life, with two cleanings per year

(c) Intial lamp cost contributes to total initial cost per luminaire (Item 12), but not to annual owning cost per luminaire (Item 13). The annual cost of lamps is an operating cost, not an owning cost

(d) Ten-year write-off at 10% per year, plus 5% for interest, insurance, and taxes

lighting systems for high mounting

V 2—H400-EW1 (k) 240 volts	VI 2—H400-R1 240 volts	VII 2—H400-RC1 240 volts	VIII 2—H400-RC1 Aluminum open top 240 volts	IX 2—H400-RW1 Aluminum open top 240 volts	X 2—H1000-RC15 (1) Aluminum open top 240 volts	XI 1—H3000-A9 460 volts	XII 2—96T12 120 volts	XIII 2—96T12/RS 120 volts
46,000	36,000	41,000	41,000	44,000	106,000	132,000	10,100	14,600
6000	6000	6000	6000	6000	6000	6000	7500	7500
400	400	400	400	400	1000	3000	74	105
860	860	860	860	860	2100	3155	174	264
.51	.59	.55	.57	.57	.54	.48	.45	.44
.65	.79	.75	.76	.76	.66	.65	.80	.76
15,260	16,780	16,910	17,800	19,050	37,800	41,200	3640	4880
.596	.542	.537	.510	.477	.240	.221	2.50	1.86
$ 59.20	$ 59.20	$ 59.20	$ 93.60	$ 93.60	$ 90.00	$201.50	$44.00	$ 52.10
$120.30	$135.50	$135.50	$135.50	$135.50	$215.00	$316.00	$45.80(j)	$ 52.80(j)
$ 29.90	$ 33.10	$ 33.10	$ 33.10	$ 33.10	$ 69.60	$ 38.30	$ 4.30	$ 5.00
$209.40	$227.80	$227.80	$262.20	$262.20	$374.60	$555.80	$94.10	$109.90
$ 26.95	$ 29.20	$ 29.20	$ 34.35	$ 34.35	$ 45.75	$ 77.60	$13.45	$ 15.75
1.21	1.19	1.18	1.30	1.21	.87	1.19	2.28	1.98
2500 4000	2500 4000	2500 4000	2500 4000	2500 4000	2500 4000	2500 4000	2500 4000	2500 4000
$21.50 $34.40	$21.50 $34.40	$21.50 $34.40	$21.50 $34.40	$21.50 $34.40	$ 52.50 $ 84.00	$ 78.90 $126.20	$ 4.35 $ 6.45	$ 6.60 $10.55
$43.00 $68.80	$43.00 $68.80	$43.00 $68.80	$43.00 $68.80	$43.00 $68.80	$105.00 $168.00	$157.80 $252.40	$ 8.70 $13.90	$13.70 $21.10
.83 1.33	.83 1.33	.83 1.33	.83 1.33	.83 1.33	.83 1.33	.42 .67	.67 1.07	.67 1.07
$12.40 $19.90	$13.75 $22.00	$13.75 $22.00	$13.75 $22.00	$13.75 $22.00	$ 28.90 $ 46.30	$ 16.10 $ 25.70	$ 1.45 $ 2.30	$ 1.70 $ 2.70
$ 1.30 $ 2.05	$ 1.30 $ 2.05	$ 1.30 $ 2.05	$ 1.30 $ 2.05	$ 1.30 $ 2.05	$ 1.30 $ 2.05	$ .80 $ 1.30	$ .85 $ 1.40	$ .85 $ 1.40
$ 1.70 $ 1.70	$ — $ —	$ 1.70 $ 1.70	$ 1.90 $ 1.90	$ 1.90 $ 1.90	$ 1.90 $ 1.90	$ 2.20 $ 2.20	$ 2.00 $ 2.00	$ 2.00 $ 2.00
$36.90 $58.05	$36.55 $58.45	$38.25 $60.15	$38.45 $60.35	$38.45 $60.35	$ 84.60 $134.25	$ 98.00 $155.00	$ 8.65 $12.65	$11.15 $16.65
$58.40 $92.45	$58.05 $92.85	$59.75 $94.55	$59.95 $94.75	$59.95 $94.75	$137.10 $218.25	$176.90 $281.60	$13.00 $19.60	$17.75 $27.20
.63 .63	.57 .57	.59 .58	.56 .56	.52 .52	.58 .58	.62 .62	.62 .59	.59 .56
.58 .58	.52 .53	.53 .53	.51 .51	.48 .47	.55 .55	.65 .65	.54 .51	.55 .53
$63.85 $ 85.00	$65.75 $ 87.65	$67.45 $ 89.35	$72.80 $ 94.70	$72.80 $ 94.70	$130.35 $180.00	$175.60 $233.00	$22.10 $26.10	$26.90 $32.40
$85.35 $119.40	$87.25 $122.05	$88.95 $123.35	$94.30 $129.10	$94.30 $129.10	$182.85 $269.00	$254.50 $359.20	$26.45 $33.05	$33.50 $42.95
.76 .72	.71 .67	.72 .68	.74 .69	.69 .64	.62 .61	.77 .73	1.10 .93	1.00 .86
.68 .64	.63 .60	.63 .60	.64 .60	.60 .56	.58 .57	.75 .72	.88 .75	.83 .72
(i)	(i)	(i)	90	.89 (estimated)	.53 (estimated)	(i)	88	83

(e) Assumed: $1.55 per lamp for 1000PS52, 750R52, 400- and 1000-watt mercury; $1.90 per lamp for H3000-A9; $1.30 per lamp for high-mounted fluorescent without starters

(f) Per cent of people who would be expected to appraise the lighting system as comfortable when seated at the middle of the rear wall looking horizontally. Does not consider reflected glare

(g) For approximately 50 foot-candles in a space 80 x 140 ft with luminaires mounted 44 ft high

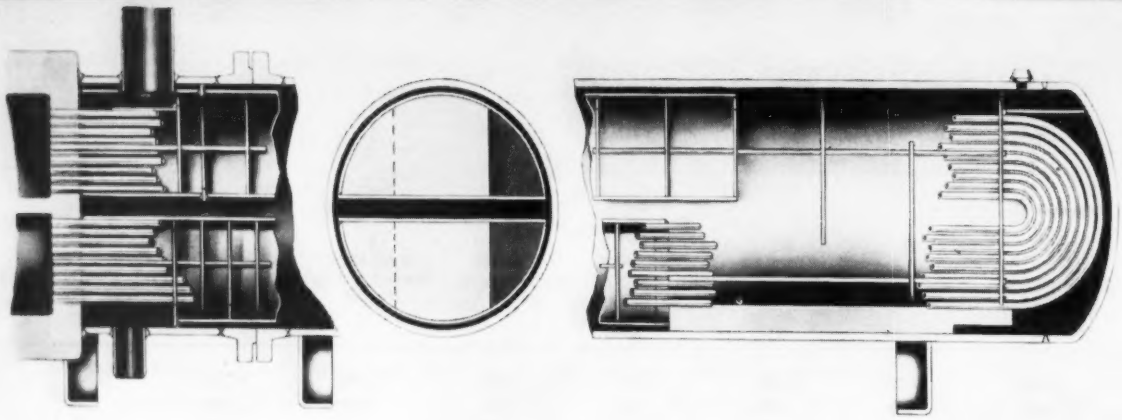
(h) For additional information see "Visual comfort index data and tables" by Meaker & Oetting

(i) Probably less than 5%

(j) In a typical installation, 277-volt distribution will result in approximately 15% lower installation and distribution system cost

(k) The H400-J1 is identical to H400-EW1 system except for 13% less light. Relative costs, therefore, are 15% higher

(l) H1000-A15 and H1000-C15 in closed-top aluminum fixtures are up to 20% higher in cost than H1000-RC15 in open-top aluminum fixture. Open- or closed-top fixture for H1000-RC15 have same cost

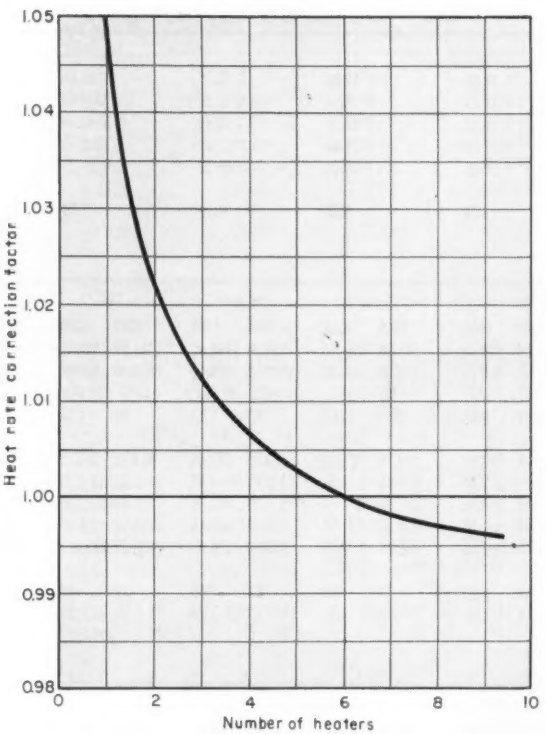


1 Many modern feedwater heaters for high-pressure high-temperature service have 3 heat-conserving sections as in this horizontal unit: desuperheating section, *upper left*, drain-cooling section, *lower left*, and main condensing section, *right*

Because they make little noise and don't move, feedwater heaters in a power plant draw little attention. But don't be fooled—they can make or break the thermal efficiency of the plant with costly results. It will pay you to learn . . .

How to choose your feedwater heaters

By **R M STEPHANI,**
Heat-transfer application engineer,
Westinghouse Electric Corporation



2 Here's how plant heat rate varies with heater number for 1800-psig 1000/1000-F 1.5-in.-Hg regenerative plant cycle

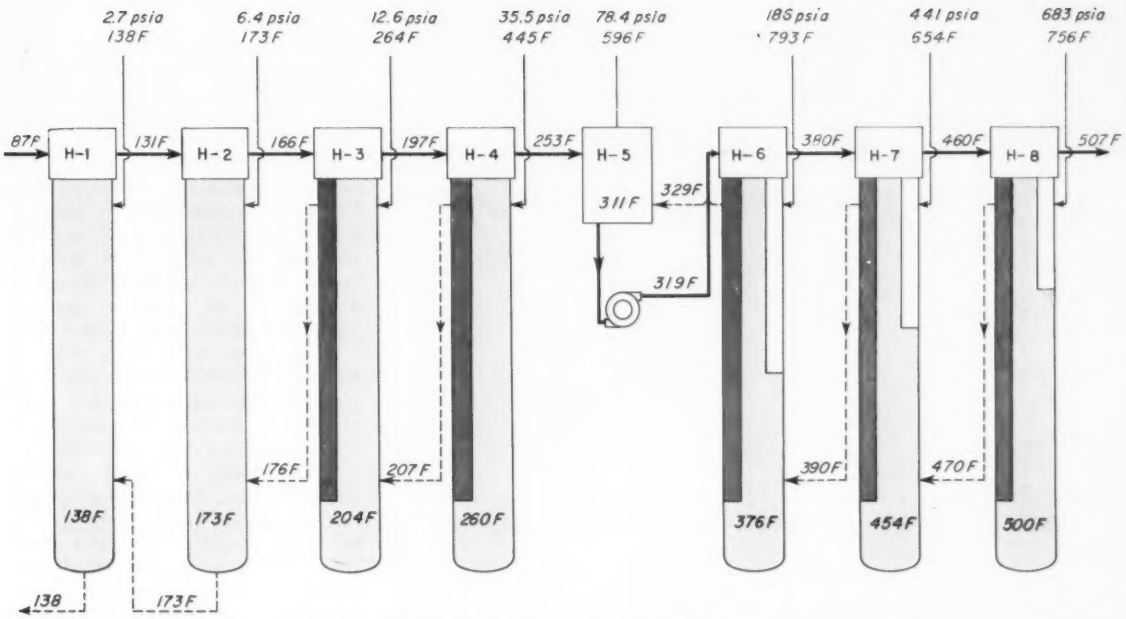
► REGENERATIVE STEAM CYCLES in electric power stations prove both economical and necessary. Boilers running at the high pressures and temperatures needed by today's steam turbines cannot withstand the thermal shock of cold feedwater entering at 90 F—the level at which it leaves the condenser hotwell. For safe boiler operation the condensate must first be preheated.

High fuel costs justify both high pressures and temperatures at the turbine throttle and also more stages of feedwater heating to produce a higher feedwater temperature to the boiler. The boiler builder usually sets the latter temperature.

Heating cycle. A series of closed shell-and-tube heat exchangers heat the feedwater as it flows from condenser hotwell to boiler inlet. Latent heat of the steam extracted from the turbine transfers to the feedwater flowing through the heater tubes. The condensed steam drains back to the lower-pressure heaters allowing it to do some additional heating there.

From the lowest-pressure heater the accumulated drains flow back to the condenser, completing the cycle. In this way the condensate of the extracted steam stays in the closed system.

The regenerative feedwater heating raises the overall station thermal efficiency, (lowers the station heat rate).



3 Heater cycle for 125-mw 1800-psig 1000/1000-F 1.5-in.-Hg steam turbine uses 7 closed units, 1 deaerating unit. Three h-p heaters have both desuperheating and drain-cooling sections, 2 intermediate units have drain cooling only

The heat rate measures one factor in the cost of producing power. Economical power plant operation depends on as low a heat rate as can be justified by the economic balance of initial cost, life expectancy and capital gain. Fig. 2 shows the improvement in heat rate with an increasing number of heaters for given cycle conditions of 1800 psig, 1000/1000 F, 1.5-in. Hg, 454-F feedwater. The optimum number of feedwater heaters can be found by balancing the cost of each additional heater against the gain in heat rate.

Analysis. Steam extracted from the turbine for feedwater heating cannot do work in the turbine and so reduces the maximum power output. But the extracted steam pays off by reducing the amount of fuel needed to make steam. Sometimes the extracted steam can be used to best advantage by building into the heater an integral drain-cooling section.

This section subcools the extracted-steam condensate below saturation temperature—usually to about 10 or 15 F of incoming feedwater—giving two important advantages:

First, the drain cooler increases the amount of heat given up by each pound of extracted steam, reducing the amount of steam needed to heat feedwater. This leaves more steam to do work in the turbine. The subcooled drains add less heat in the lower-pressure heater and so raise the steam demand of that heater. But this steam will have less energy because of the additional work it has done in expanding through the turbine. The net result uses less steam of higher energy content and so produces more kw output for the same amount of heating.

Second, subcooling the drains reduces the amount of flashing as their pressure drops in flowing to the lower-pressure heater. This reduces: (1) erosion of throttling devices and piping (2) noise and vibration of piping caused by mixture of steam and water.

Design factors. Difference between temperature of the subcooled drains and incoming feedwater is the *drain cooler approach*. As this difference decreases, the rate of heat transfer decreases, and must be compensated by additional heat-transfer surface. This raises the heater cost.

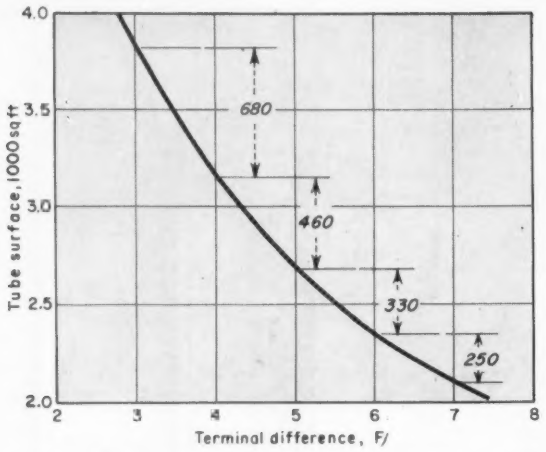
An economic study determines the degree of approach that can be justified. Particular attention should be given to subcooling the drains from the lowest-pressure heater; the first heater the main condensate enters. These drains usually flash back to the condenser where their heat content goes to the cooling water and is lost to the cycle. An approach of less than 10 degrees is sometimes justified at this stage heater.

Figure 3 shows the heater arrangement in a typical cycle. Since plant design dictated vertical heater installation, the two lower-pressure heaters do not have integral drain coolers. Even though drain coolers could be justified economically, the vertical arrangement precludes their use.

Drain-cooling sections must be built around the tubes carrying the coldest inlet water. In a vertical heater with water inlet at the top, the drains must be raised the full length of the tubes. This must be done by the differential pressure across the drain cooler. At the low pressure in these two heaters, Fig. 3, this cannot be done. This could have been avoided by installing the heaters horizontally to eliminate the difference in elevation.

Boiler needs fix the inlet feedwater temperature. The turbine designer can select the extraction pressure to the last heater accordingly, knowing the water can be heated to about the saturation temperature of the extracted steam. After figuring the optimum number of heaters, the turbine designer can set the extraction pressures of the other heaters by proportioning the steam flow to be about equal. In a reheat unit the steam flow from the extraction point just before the reheater should be about double the other extractions—this usually proves the most economical.

Temperature selection. To what temperature should the water be raised as it passes through each heater? Here we use *terminal difference*—the difference between feedwater temperature leaving the heater and saturation temperature of the entering steam. Since



4 To achieve one degree lower terminal difference in a feedwater heater takes increasing amounts of sq ft tube surface

the amount of heat-transfer surface in a heater varies inversely to the logarithmic mean temperature difference (lmtd — average difference between steam and water temperatures), the terminal difference greatly influences the heater cost.

When extraction steam has none or a small amount of superheat, we consider it to be at saturation temperature. Only an infinitely large heat-transfer surface could reduce the terminal difference to O F—prohibitive from an economic standpoint. Actually we find it impractical to heat the water to less than 3 F of saturation temperature for a condensing-type heater.

The cycle of Fig. 3 could economically justify negative terminal differences on each of the high-pressure heaters. This means that the water outlet temperature is higher than the steam saturation temperature. This can only be done with entering superheated steam confined to surround the tubes carrying the water just leaving the heater. Isolating the steam in this separate *desuperheating section* allows transferring the sensible heat of the steam to the feedwater.

To proportion the heater surface, temperature of feedwater entering the desuperheating section should be calculated. The lmtd and the heat-transfer surface needed can then be found. To calculate the surface needed in the condensing part of the heater, we must find the terminal difference at the entrance to the desuperheating section. Pressure in the condensing zone will be lower than incoming steam pressure owing to the unavoidable pressure drop through the desuperheater. This difference, as in a simple condensing heater, should not be less than 3 F.

Economics. Besides thermal and economic limitations affecting heater selection, physical size of the heater must also be considered. Manufacturing, shipping or installation space may cause some limitation on size that can be accommodated. If a heater proved to be too large, it would be necessary to reduce the amount of heating in this unit and raise the duty of the heater next in line. These limitations are difficult to predict prior to actual design and should be worked out jointly by plant and heater designers.

A major aim of power plant design is to improve the heat rate of the steam cycle. Once the number of heaters and their pressures have been determined, we must select the proper heater terminal difference to improve the station heat rate. The heat rate should be evaluated in dollars per Btu per kwhr.

Since smaller terminal differences (td) increase the cost of a heater, various td's should be studied from an economic standpoint. When the increase in cost is less than the evaluation of gain in heat rate, the higher outlet temperature is justified. Study results for one power plant may be entirely wrong for another because of the difference in cost factors. Fuel costs, labor costs, transmission costs, station capabilities all influence the value of an improvement in heat rate.

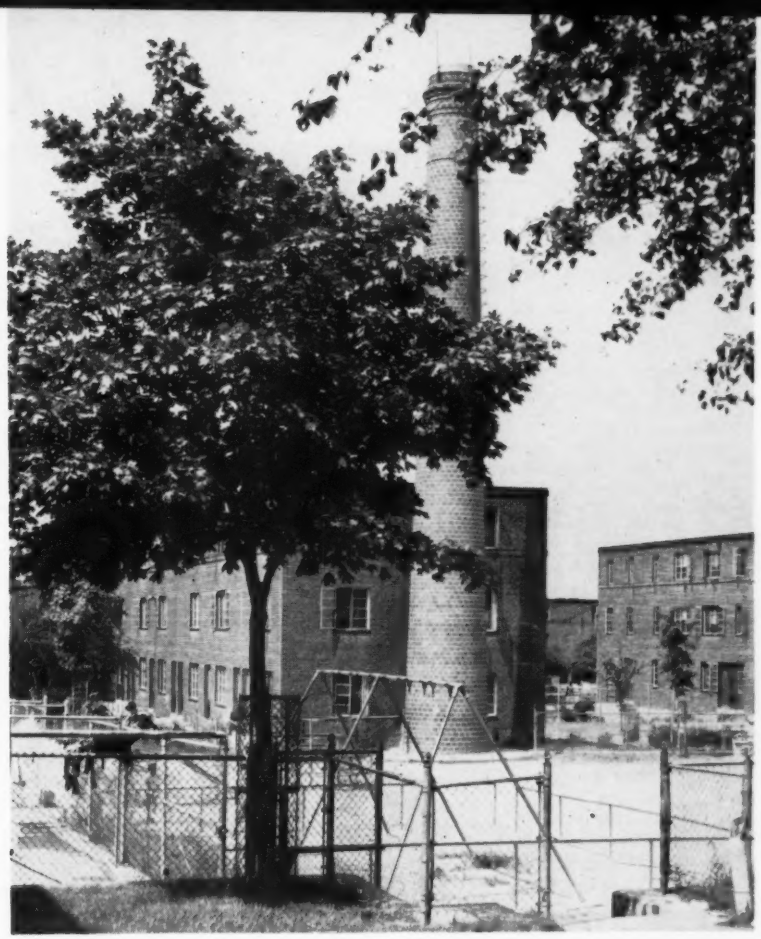
Size of a feedwater heater is roughly a hyperbolic function of the terminal difference, Fig. 4. This curve was developed for nonsuperheated steam, thus eliminating negative and zero terminal differences.

In determining the optimum td, studies should be made on the basis of 1-F increments. Let's illustrate this by an example where the station heat rate will be evaluated at $5000 per Btu per kwhr. Usually a degree lower terminal difference will improve the heat rate by 1 Btu per kwhr; for this case 1 F will be evaluated at $5000. If the cost of the heater was increased $2000 in designing it for a 5-F td instead of 6-F, and then increased another $6000 in designing for 4-F td, the 5-F td would then be the optimum. If we looked at this only from an overall change from 6 F to 4 F, the total cost increase would be $8000 for a $10,000 saving. This would give the false impression that a 4-F td could be justified. This case would also be true for a study of negative td's.

Heater design. Along with consideration of thermal, practical and economic limitations, the heater designer must be aware of other controlling conditions. For a given amount of heat-transfer surface, lengthening the heater reduces the cost. A given tube diameter has a fixed surface per unit length. Needed total surface can be obtained by properly selecting the number and length of tubes. A fewer number of tubes could be put in a smaller diameter shell, reducing the necessary thickness of shell plate, flanges, water chamber covers, etc—all of which greatly reduce the cost. The slightly extra cost of longer shell plate that would be needed can easily be justified.

Longer heaters have a disadvantage. Water flow in lb per hr is fixed, so the velocity of water flowing through fewer tubes will be higher. This raises the pressure drop through the heater and needs more pumping power. Pumping power costs must be balanced against heater costs to find the optimum design conditions. The terminal difference, however, has a direct bearing on the heat rate and will prove to be the larger factor; so be sure to give it proper attention.

Finding the optimum conditions for a heater design cannot be done easily. Even though a certain terminal difference or drain cooler approach may be justified by economics, further terminal and physical limiting conditions must also be investigated. Terminal differences in the condensing zone of a heater should not be less than about 3 F. Does enough differential pressure exist between heaters to operate a drain-cooler section? What is the maximum size and weight allowed? These limitations must all be satisfied. With proper awareness of these factors, plant designers and heater designers should be better able to understand their common problems and work out the best solution for each steam-electric generating station.



By E M STOLBERG
Formerly mechanical superintendent

Baltimore Housing Authority's steam plant consolidation proves that . . .

Planning can make 1 = 7

► THE NEW Central Avenue heating plant of the Baltimore Housing Authority steams merrily along, supplying heating and hot water to five separate public housing projects, and thereby hangs a tale. A tale that points up how a thorough situation analysis plus engineering know-how is saving taxpayers some $70,000 a year.

Before the new plant was built, three existing housing projects were getting heating and hot water from five separate boiler plants. Each plant, in addition to its regular labor costs, had duplicate expenses of maintenance and repair, utility services, insurance and miscellaneous overhead charges. Summed up—it wasn't an economical setup.

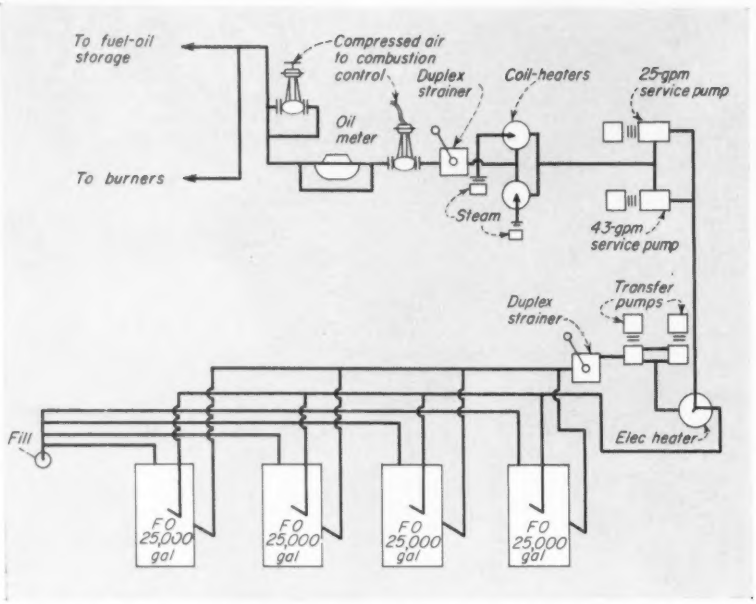
Two new housing projects in the design stage added to the problem. Time-honored custom in the public housing field called for separate boiler plants for each of the new projects. But, certain that a workable solution was possible even though it meant a break with tradition, Housing Authority officials and their consulting engineers put their heads together, came up with the consolidation scheme. Result: The new central plant involving only a single operating crew, eliminated the five existing plants with their duplicate expenses and scratched the need for the two new plants.

Two 2-drum 120,000-lb-per-hr boilers provide steam for heating and hot-water generation. More than a mile of prefabricated insulated piping makes up the underground high-pressure (235 psi) steam distribution system serving the five housing projects. Two-stage reducing stations bring the steam down to 15-psi service pressure.

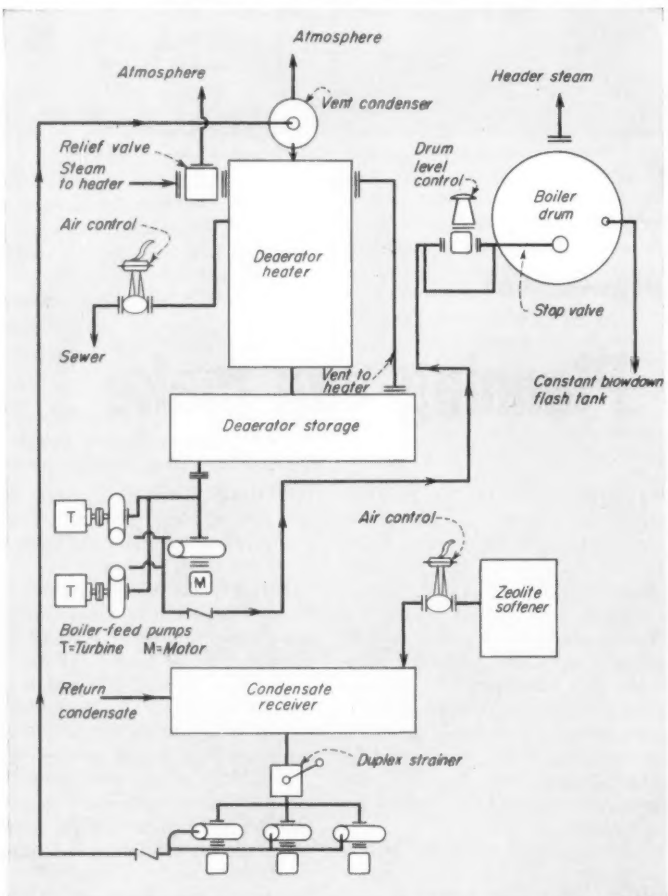
Fuel is bunker C plus additive. Transfer pumps pick it up from four 25,000-gal underground storage tanks, send it through electric heaters to the screw-type service pumps. They send the oil through steam-coil type heaters (which up the temperature to 200 F) and to the steam-atomizing type burners.

Possibility of any emergency curtailing or eliminating fuel-oil supply was considered in plant design. Provision was made for continuous ash-discharge stoker firing and space was allotted for coal bunker installation should the need for it arise.

I-d and f-d fans supply regulated



FUEL OIL handling system from underground storage tanks to burners is compact, efficient. Plant design provides for stoker firing, coal bunker space in emergency



FEEDWATER TREATMENT includes softening, chemical injection, deaeration. Plant's test lab runs daily control checks to maintain purity standards

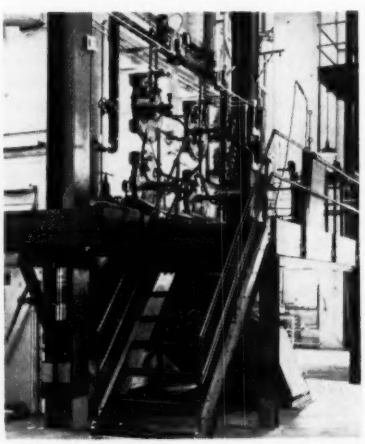
and controlled air to the combustion process and remove products of combustion in an efficient and effective manner. Pneumatic piston-controlled linkage actuates fans' intake damper vanes to regulate gas volumes and a ring balance pneumatic system holds close control of the entire combustion process.

Feedwater supply to the boiler drums is through a level regulator. A controller maintains an 85-psi differential hydraulic pressure at the feed pump to insure adequate feed without drum surging or control hunting. Three feed pumps, (500-, 300- and 60-gpm) provide for any change in winter or summer operating requirements.

Feedwater treatment includes sodium zeolite softening, chemical feed and blowdown. Primary treatment softeners deliver zero hardness makeup. Proportioning pumps inject chemical feed into deaerating heater and boiler drums. Regulated continuous surface blow plus a once-per-shift bottom blowdown hold solids to a minimum. The plant's test lab runs daily control checks to insure maintenance of water purity standards.

In addition to boiler-water treatment, a filming amine injected into the main steam header helps to guard against steam and return-line corrosion. These underground lines run below some heavily traveled streets and a piping failure could produce a rough problem.

Electrical service. Two parallel 14.4-kv feeders drop down to an isolated and locked basement compartment. (Though only one's used at a time, parallel feeders insure against service interruption if one goes out). The unit substation houses the transformer (440-v secondary) and starting switchgear for major electrical equipment. Associated units have individual starters located nearby.



BOILERS, 120,000 lb per hr, have steam-atomizing burners mounted in sidewalls

Principal power-plant equipment

Steam production equipment

Boilers — Erie City Iron Works
120,000 lb per hr each (144,000 lb per hr for 2-hr peaks), 2-drum type, 250 psi at take-off, 235 psi operating pressure. Presently firing residual oils but arranged to permit future continuous ash-discharge stoker firing. Boiler heating surface, 14,069 sq ft. Tubes, 912 2½-in. and 60 3¼-in. Each boiler has four Todd steam-atomizing oil burners located on sidewall, approximately 10 ft above boiler floor level

Fans, 2 f-d, 2 i-d — American Blower Corp
F-d fans, 1175 rpm, constant speed, 40 hp motor driven, 38,500 cfm
I-d fans, 745 rpm, geared turbine drive with alternate 30-hp belt-connected motor drive, 84,600 cfm

Boiler-water level control, 2 — Copes-Vulcan Div, Blaw-Knox Co

Soot blowers, 2 sets per boiler — Copes-Vulcan Div, Blaw-Knox Co
Type P-3, double system having elements entering each side of boiler, two Hyouley, four Vulchrom, four plain steel, rotating

Feedwater equipment

Boiler-feed pumps, 3 — Worthington Corp
Centrifugal, two turbine-, one motor-driven. One, 500 gpm; one, 300 gpm; one, 50 gpm

Condensate pumps, 3 — Worthington Corp
Centrifugal, motor driven, 1750 rpm, 90-ft max head. One, 500 gpm; one, 300 gpm; one, 150 gpm

Feedwater heaters, 1 — Belco Industrial Equip Div
Bogue Electric Mfg Co
Deaerating, 240,000 lb per hr, 5 psi. Combined with 2900-gal hot-water storage tank using either exhaust or live steam

Softeners, 2 — Hungerford and Terry, Inc
Cold-zeolite, exchange capacity 100,000-gal zero hardness water, max softening rate 165 gpm

Chemical-feed pumps, 2 — Milton Roy Co
One simplex, one duplex, motor driven, gear reducer 24:1

Fuel-handling equipment

Fuel-oil service pumps, 2 — DeLaval Steam Turbine Co
Motor driven, 1170 rpm, 200 psi

Fuel-oil circulating pumps, 2 — DeLaval Steam Turbine Co
Motor driven, 1150 rpm, 54 gpm, 25 psi

Instruments and control systems

Combustion controls — Hagan Chemicals & Controls, Inc

Steam flow, air flow, stack temperature recorders — Hagan Chemicals & Controls, Inc

Ranarex CO_2 recorder — Permutit Co

Smoke indicators — Brooke Engineering Corp

Remote level indicators — Reliance Gauge Column Co

Condensate meters — Burgess-Manning Co, Penn Instrument Div

Draft gages — Ellison Draft Gage Corp

Fuel-oil-tank level indicators — Liquidometer Corp

Miscellaneous equipment

Air Compressors, 4 — Worthington Corp; Brunner Mfg Co

Sump pumps, 2 — General Dynamics Corp

Transformer — Eisler Engineering Co
500 kva

High-voltage switchgear — Wolfe & Mann Mfg Co

Breakers — General Electric Co

Lighting panels — Frank Adam Electric Co

Motors — Louis Allis Corp; General Electric Co; Peerless Electric Co; Westinghouse Electric Corp

Consulting engineers — Egli and Gompf, Inc

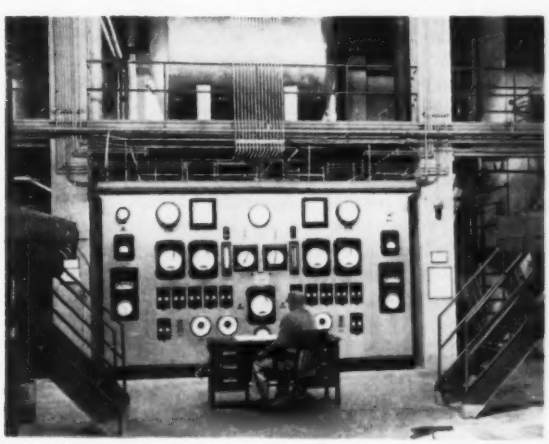
Plant lighting comprises incandescent overhead fixtures plus fluorescents in strategic areas. External spotlights are a safety measure and reduce the possibility of vandalism.

Audio and visual alarms and controls guard fuel oil, air supply, combustion control and feedwater systems. Boilers have high- and low-water alarms plus water level controls and indicators both at the drum and on the control panel. Flame-failure scanners on each boiler back up the pneumatic combustion-control system.

Plant piping is color-coded for easy identification and general good looks. A once-a-year cleaning or painting schedule provides for good housekeeping, shows up minor leaks or flaws.

The new plant has proved itself from the standpoint of (1) dollar savings (2) improved service to tenants (3) reduced maintenance (4) reliability. Both architecturally and technically, it's an asset to plant facilities, to community appearance and to our relations with the general public as a whole.

MAINTENANCE made easy through roomy layout. Condensate receiver, pumps, f-d fan are spotted below operating floor



OPERATING PANEL centralizes control. Visual and audio alarms tell of unusual water level, firing, combustion conditions

Fundamentals of cooling-tower operation: fans, inspections, water-control measures

The author considers the important causes of fan blade loads and how to relieve them, gives essential tower-operation data, explains methods of controlling water pH, algae growth

By DONALD SWIFT, *Ebasco Services Incorporated*

► IN FEBRUARY we described the types of cooling towers and where to locate them. Now we go into further details about operation.

Cooling tower fans. Fans are perhaps the most important part of mechanical draft towers. They are the main moving elements and as such can cause the most trouble. Good static and dynamic balance avoids undue vibration of tower and fan supports and undue stress on fan bearings.

Forced-draft fans are normally mounted on pedestals set solidly on the ground. Their diameter may not be too large, so vibration is not as likely to be troublesome.

Induced-draft fans, however, often have very large diameters. Also, they are set on the tower framework which is elastic, not absolutely rigid. Vibration may be difficult to control. For good balance, see that blades have equal weight and dimensions and are mounted symmetrically. Balancing this type of fan dynamically is difficult and dangerous unless you have special equipment for remote balance indication.

Several causes may set up large fatigue-inducing fan blade loads: (1) Mechanical vibration and centrifugal forces associated with fan rotation (2) Unsteady air flow and stresses resulting as fan blades pass tower framing or other obstructions near the fan path. The pulsating-air loadings usually recur rapidly. Blade failures caused by fatigue action may result.

A number of blade types and constructions have been used in attempting to minimize the problem. These include steel, aluminum, stainless steel and laminated wood or fabric molded with some form of plastic as a binder. Fatigue failures have mostly occurred near the blade root where the stress is the highest. Reinforcing metal blades internally and using flexible mountings have been tried to avoid localized high stresses. Some methods have been rather successful.

Inspect fan blades regularly, check for cracks at blade fastenings and points where fatigue might occur.

Blade shape and surface smoothness affect fan efficiency. Laminated blades are subject to deterioration and roughening at the leading edge. Covering this edge with a strip of thin copper or monel often helps prevent deterioration and loss of efficiency.

Check blade fastenings and adjust if necessary. Be sure they are tight and that blades are all in the same plane, set at the same angle. A gage facilitates setting blade angles. If not provided, you can fabricate one rather easily.

Usually it is best to set fan blade angle so motor power doesn't exceed gear reducer rating or motor rating at low ambient temperature. If motor voltage is not at rated level, but will be constant at the level at which test is made, full current loading should still be satisfactory.

Air recirculation at the fan often reduces fan air-moving capacity. Air may recirculate near the center, or around the tips of the blades. Baffle plates are usually provided at the fan center. Pulsating air pressure found here often causes fatigue failure of plates or fastening bolts. Check center plates and fastenings at each fan inspection.

A baffle ring is sometimes used to control fan tip recirculation. This ring has the same or slightly smaller diameter than the fan. It is set closely ahead or behind the blades to reduce the area available for recirculation. When setting blades, remember that they (1) are elastic and deflect somewhat under load (2) must clear the baffle.

Fan drives. Service conditions for worm or spur gear drive on which induced-draft fans are mounted are rather severe. Surrounding air is moist, warm and fan unbalance may set up stress in the gear. Use a grease or oil suitable for operating conditions and check lubrication at frequent intervals.

Make sure gears run in the proper direction. Running them backwards may cause trouble. Clearances required may be different depending on the direction of rotation.

See that gear case is firmly bolted to a solid footing after aligning accurately with the drive shaft. Align motor and gear while fans are being installed and make occasional checks thereafter. Temperature changes and long service periods generally cause swelling and shifting of tower framework.

Shaft bearings and flexible couplings

operate in moist ambient air. Choose lubricant carefully and check service results frequently, say once a week, until you know that lubrication is being well maintained and grease or oil is not being lost. Lubrication intervals may then be increased as experience dictates.

Fan-drive motors are usually totally enclosed or weatherproof. They should need little attention except for lubrication. Make sure they are tightly bolted down to maintain shaft alignment and avoid vibration.

Fire protection. A cooling tower is made almost completely of small dimension dry wood. So it may be a fire hazard from the time it is partially erected until it is put into operation.

Install fire hoses, backed up with adequate water pressure, as soon as possible. Keep tower wet down with the hoses or by circulating water over it. This decreases the possibility of fire damage. Take similar precautions during subsequent shutdowns. Remember: cooling tower damage can often put an entire plant out of operation.

Preliminary operations. After tower is erected, clean thoroughly. Remove wood blocks and chips, dirt, concrete forms, bolts, other construction debris. Inspect the fans and drives. Check water piping and distributing troughs to see that valves, baffles, plugs, etc are in place. Inspect tower basin for cleanliness and signs of cracks. See that drains and overflows are clear and in place. Check outlet screen chamber and screen installation. Clean, inspect and close up openings on inlet and outlet water conduits. Check circulating water pumps to be sure they are free from obstruction and properly installed and aligned. Fill tower basin and tunnels with water—preferably of the type that will be normally used—then look for leaks and cracks. If you find trouble, it is usually better to make corrections before proceeding further.

When the water system is free from leaks, start pumps to move water over the tower. Start flow slowly as air pockets and water surges may strain or damage the piping. After you establish full normal water flow, adjust valves and gates to equalize the flow between all tower cells and between individual parts of each cell.

You can start and try out fans either before or after turning on water. Make a final check of lubrication, hold down bolts and fan clearances before turning on power. See that fans rotate in the proper direction. Make a preliminary check of blade setting without water flowing over the tower and a final check with normal water flow and temperatures. Difference in ambient air temperature and specific weight of the air handled by the fans materially affects power requirements, especially on induced-draft towers.

With everything on the tower in operation, make a preliminary overall check of fans, air and water distribution and spray elimination. Check fan motors, drive bearings and lubrication frequently until the equipment has had time to wear itself in and demonstrate its operating characteristics.

Tower outlet screens may have to be cleaned frequently for a few days until loose chips and shavings have been washed out of the inaccessible portions of the tower. Note points of leakage through the tower casing for future correction.

As soon as tower load conditions become normal, check wet-bulb temperature, leaving-water temperature, range and flow. Official acceptance tests may have to await warm weather and full load conditions to which guarantees apply. But performance correction curves are usually supplied. These may be used to adjust guarantees to actual operating conditions if they are not too far from normal.

Water control. Almost as soon as a tower is placed in operation, start makeup water feed to replace evaporation and spray losses. Water evaporated leaves its impurities behind. This builds up the concentration of dissolved or suspended solids remaining in the tower. Makeup water brings in additional impurities. Spray lost carries off a proportionate amount of these impurities but additional blowdown is usually required to hold impurities at the usual two or three times concentration. This gives fair freedom from scale formation without excessive makeup.

Each water and tower situation has its own characteristics, however. Concentrations up to 5 or 6 times may be possible. Tower water analysis and calculation of its Langlier index — tendency of water to deposit calcium carbonate scale under given conditions —indicates the approximate concentration possible. Ortho-phosphates, lignins or similar surface-active materials may be used to decrease tendency for scale deposits or for corrosion to occur. A continuing close check on condenser terminal difference indicates whether scale deposits on warm tubes are building up and affecting heat transfer. This confirms the Langlier index indication.

Basic material deposited on condenser tubes as water concentrations increase is usually calcium carbonate scale. If carbonates in the water can be changed to sulfates, which are more soluble, higher concentrations are often possible and makeup water requirements are reduced. At the same time, water alkalinity and pH are reduced. This makes for more favorable operating conditions for tower wood. However, calcium sulfate scale is much more difficult to remove, so concentrations must be closely controlled. Sulfuric acid fed intermittently or continuously to the tower accomplishes this purpose. The reaction proceeds as follows:

$$CaCO_3 + H_2SO_4 = CaSO_4 + CO_2 + H_2O$$

The CO_2 is released to air and alkalinity and pH of the tower water is reduced. Be sure to control sulfuric acid feed carefully because an excess may reduce pH low enough to cause a seriously corrosive condition. If allowed to continue, this might damage the metal portion of the condensing water circuit.

Low pH will also gradually reduce scale deposits in the system. But danger of corrosion may be worse than the effect of scale. If a heavy scale coating has accumulated it is probably better to acid-clean the condenser and thereafter keep the condensing water in proper balance.

Use of sulfuric acid requires storage, dilution tanks and some form of feeder. Continuous feed to maintain desired pH is preferable.

Feed acid into system where it will mix rapidly with the water and where low pH will not cause damage. Addition near point of makeup water entry may be desirable. Temporary excess acid feed or poor mixing may result in corrosive conditions. Acid solution lines and feeder nozzle are usually made of lead, glass or acid-resistant plastic material to resist action of the dilute acid. Handling and using sulfuric acid is always dangerous. Use proper methods and equipment to avoid accidents.

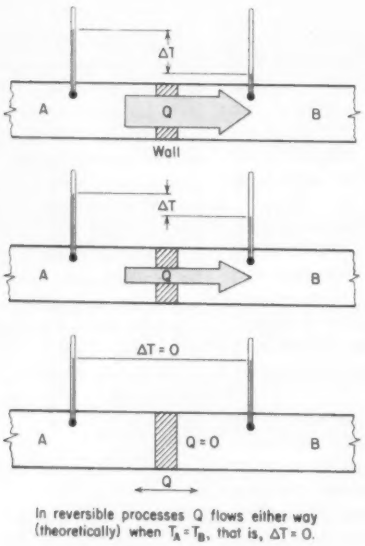
Sample the water at a point some distance after the acid feed point so your sample shows the effect of the acid, but not so far away that a long time delay is experienced.

Where acid feed is controlled manually, check about once an hour. When using a pH cell and automatic control, test once per shift and review equipment operation hourly.

Sulfur burners are sometimes used

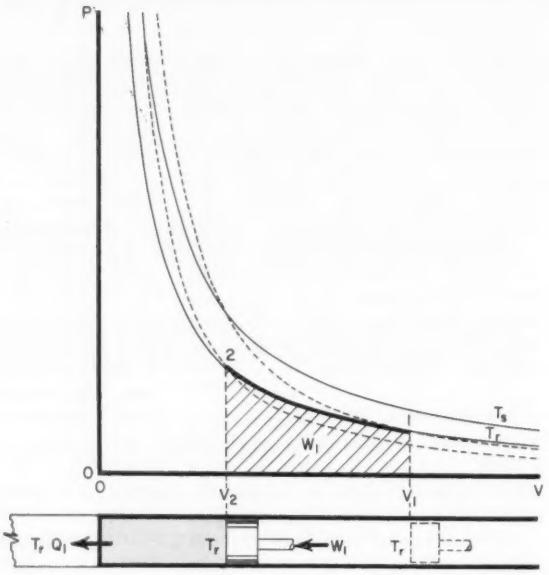
(*Continued on page* 212)

THERMO REFRESHER NO. 9



In reversible processes Q flows either way (theoretically) when $T_A = T_B$, that is, $\Delta T = 0$.

1 Actual heat transfer depends on temperature difference making Q flow



2 Carnot cycle works between pair of constant-*T* curves and pair of adiabatic curves; receiver absorbs rejected Q_1

Finding out what limits the performance of heat engines is a major aim of thermodynamics. Here we look at one of the basic cycles to find out how . . .

By B G A SKROTZKI
Associate Editor

Carnot engine spells out possibilities

► WE HAVE STUDIED a variety of processes that a perfect gas may undergo when held in a cylinder behind a frictionless leakproof piston. We're almost ready to see how these processes can be put together so they can steadily transform heat to work or work to heat. But first we'll have to expand our ideas about reversibility.

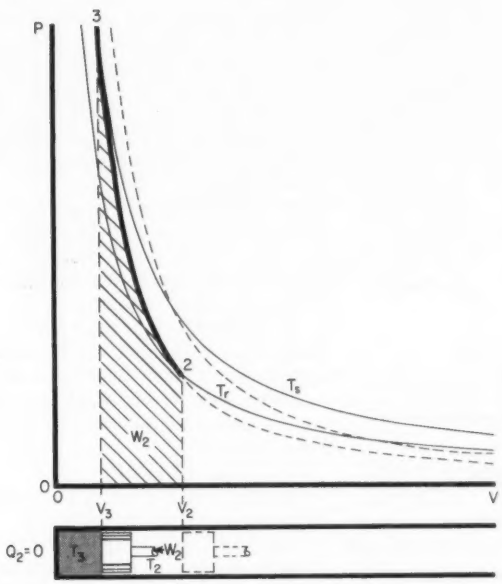
Thermal reversibility. In Part 7, April 1957, p 97, we talked about reversibility, which we should now pinpoint as *mechanical reversibility*. This refers to the ability to reverse any process so all the gas properties (P, T, V, E) through which the gas passed during the original process would be *exactly* retraced during reversal. In addition, any energy as heat Q or work W expended or absorbed during the original process would be *exactly* repaid during the reversal. This can never be realized practically. Later in this series we'll talk about irreversible processes.

Another important idea is *thermal reversibility*. This also is only an ideal condition, one that can't be attained. By experience we learn that we can only transfer heat from one body to another when their temperatures differ, Q flowing from the hotter to the colder. Some writers propose that this be called the Zero Law of Thermodynamics—meaning that this should be propounded before the First Law; and that it is a principle of equal importance.

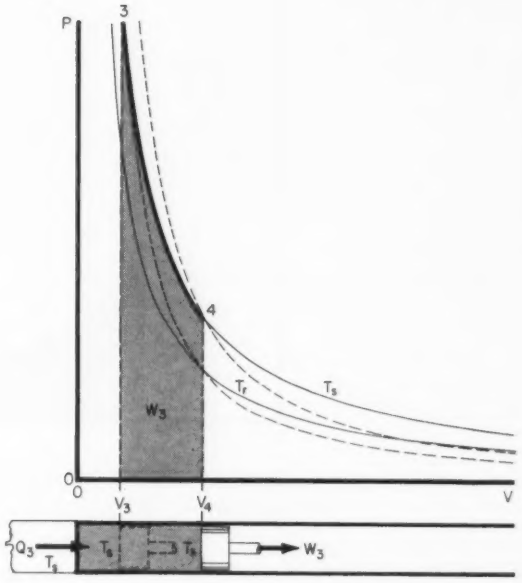
Fig. 1 shows two gases A and B separated by a wall. Heat Q flows from A to B because of their temperature difference ΔT. As ΔT decreases, Q shrinks, till it disappears just as T equals zero. For a process to be thermally reversible Q may be transferred in either direction when $\Delta T = 0$. At first glance this looks like a silly idea, but it has importance in setting up an ideal benchmark against which to measure practical performances of heat engines. When we apply this notion in the following process analyses, close your mind to the fact that it can't be done and look upon it as an ultimate limit—the best we could do in an Utopia.

Carnot cycle. In our studies of the gas processes we learned they can convert heat to work. A single process is not of much practical use—we need an arrangement that will cause this conversion as a steady procedure; something that will alternate the piston motion back and forth so it could turn a wheel through a mechanical linkage. This means that the gas should alternately expand and contract.

We do this by making the gas go through a regular series of processes. Such a series is called a cycle, because



3 In second process Carnot engine completes compression stroke adiabatically so W_2 raises gas temperature to T_s



4 In third process Carnot engine begins expansion stroke by absorbing heat input Q_3 at constant temperature T_s

they continually repeat in making the engine work. Sadi Carnot, in 1824, was the first to propose a cycle that proved to be a fundamental analysis of great value. The odd thing about his proposal—it was made when heat was thought to be a tangible substance. This mistake, fortunately, did not affect the validity of the analysis in showing how the cycle changes heat to mechanical work and vice versa.

Carnot needs three main things to make his cycle work: (1) a perfect gas confined in a cylinder and piston (2) a source of energy at temperature T_s (3) a receiver of energy at temperature T_r. In Fig. 2 the gas in the cylinder is initially at T_r and V_1. Graph, above, has two constant-temperature curves for the gas at T_r and T_s. Crossing these are two adiabatic lines (dotted), processes through which the gas can expand or contract without transferring any heat Q.

Now let us analyze the Carnot cycle, step-by-step:

First process, Fig. 2. We bring the cylinder head (and so the gas) in contact with the receiver at temperature T_r. Work input W_1 compresses the gas from V_1 to V_2 and rejects heat Q_1 to the receiver at constant T_r as a mechanically and thermally reversible process. Area under the process *1-2* on the *P-V* graph measures the amount of work done on the gas, W_1. Since the temperature stays constant, $Q_1 = W_1$ according to simple energy equation.

Second process, Fig. 3. At state *2* we remove the receiver and continue compressing the gas in a reversible adiabatic process. It takes work W_2 to compress the gas to state *3*, that is, volume V_3. During the process *2-3* the gas temperature rises from T_r to T_s; and $Q_2 = 0$. All the work goes to raising the internal energy of the gas:

$$W_2 = E_3 - E_2 = c_v (T_s - T_r)$$
$$= c_v (T_s - T_r)$$

Third process, Fig. 4. We now bring the cylinder in contact with the source at temperature T_s and let the gas expand reversibly at constant T_s to V_4. During process *3-4* the gas absorbs heat Q_3 and does work W_3. Since the temperature and internal energy of the gas does not change $Q_3 = W_3$.

Fourth process, Fig. 5. This process brings us back to our starting point and closes the cycle. To reach this we remove the source from the cylinder and let the gas expand adiabatically and reversibly to state *1*. Again for an adiabatic process we have $Q_4 = 0$ but

$$W_4 = E_1 - E_4 = c_v (T_s - T_r)$$

Summary. For all processes the area under the curves in Fig. 2 to 5 measure the amount of work done on or by the gas. Let's review what's happened during the cycle: (1) The piston has made two full equal strokes between fixed endpoints, V_1 and V_3. (2) During the compression stroke work W_1 and W_2 was done on the gas. (3) During the expansion stroke work W_3 and W_4 was done by the gas. (4) During part of the compression stroke heat $Q_1 = Q_r$ was rejected to the receiver at constant temperature T_r. (5) During part of the expansion stroke heat $Q_3 = Q_s$ was added to the gas by the source at constant temperature T_s.

By plotting all four processes on the *P-V* graph, Fig. 6, we can estimate what has happened energy-wise. Remembering areas under process lines measure work done on or by the gas, we see that the compression work done *on* the gas (hatched area) is less than the expansion work done *by* the gas (gray area). The net area *1-2-3-4* measures the net work done by the cycle:

Net $W = W = W_3 + W_4 - W_1 - W_2$

when we regard all quantities as positive. We could have written this equation as the sum of all works and let the negative signs of the 1st and 2nd processes take care of the subtraction.

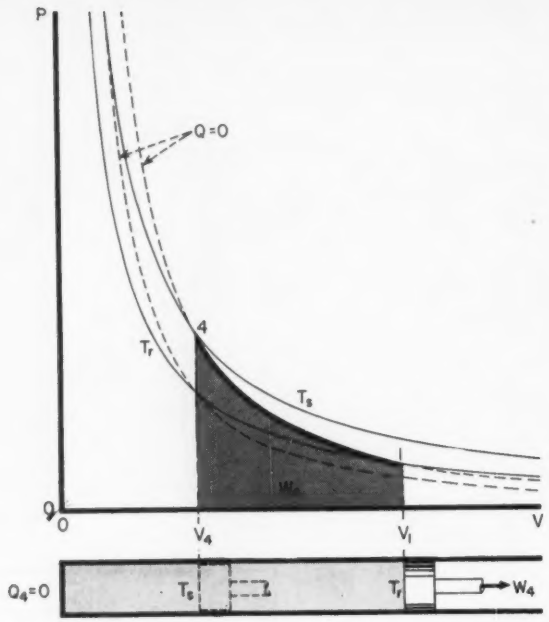
Heat has been added to the gas by the source and rejected by the gas to the receiver so the net heat energy input to the gas is:

$$\text{Net } Q = Q = Q_s - Q_r$$

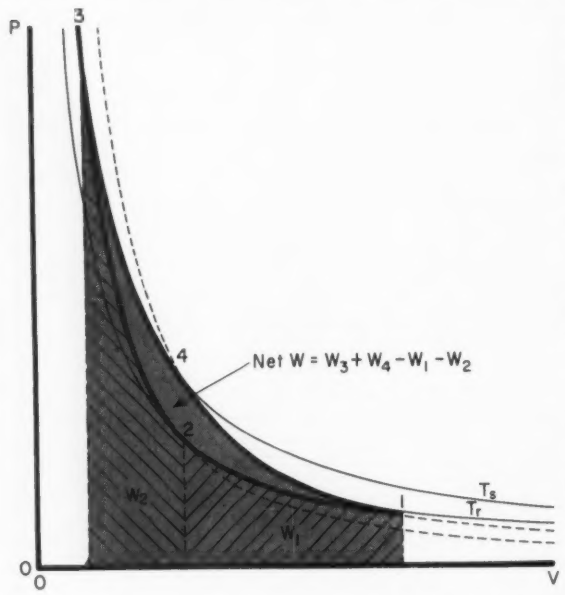
Since the gas has gone through four processes of the cycle and ended up in exactly the same state (P_1, V_1, T_1) it has the same internal energy it started with. So all the net transient forms of energy must be equal or:

$$Q = W$$

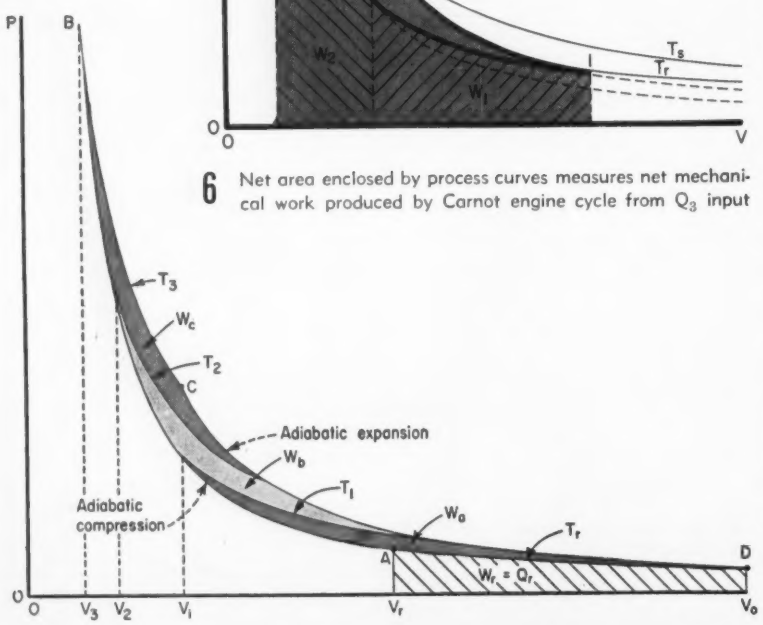
This means that although the gas has drawn a total heat energy of Q_s from the source and rejected a smaller energy Q_r to the receiver, it has "retained"



5 In fourth process Carnot engine completes expansion stroke by expanding gas adiabatically to receiver temperature T_r



6 Net area enclosed by process curves measures net mechanical work produced by Carnot engine cycle from Q_s input



7 Carnot engine output per cycle may be increased by raising the source temperature from T_1 to T_2 to T_3; this requires succeedingly longer piston strokes

a net Q and converted all of it to useful work W, often called the *shaft work*.

Fig. 6 shows one feature of reciprocating engines not generally appreciated: the large flows of work energy into and out of the gas yields a relatively small net work output. Note how small the net area is compared to W_1, W_2, W_3 and W_4.

Adiabatic processes. To get back on the main track of the discussion, we find that the adiabatic processes, the 2nd and 4th, involve works that are both equal *numerically*, that is:

$$W_2 = W_4 = c_v (T_s - T_r)$$

Since W_2 is work input and W_4 is work output, they cancel each other as far as contributing to net W of the cycle. On the other hand the 1st and 3rd processes show:

$$W_1 = Q_r \text{ and } W_3 = Q_s$$

since they're both constant-T processes. Then we can write:

$$W = W_3 - W_1 = Q_s - Q_r = Q$$

Cycle efficiency. The Carnot cycle being an ideal reversible cycle is one of the most efficient. But the thermal efficiency may be far from 100%. Thermal efficiency, like any efficiency, is the ratio of energy output to input. For the Carnot cycle, the output is the useful net W, but the energy input is the amount drawn from the source Q_s, so the thermal efficiency is:

$$e_t = \frac{W}{Q_s} = \frac{Q}{Q_s} = \frac{Q_s - Q_r}{Q_s} = \frac{W}{W + Q_r}$$

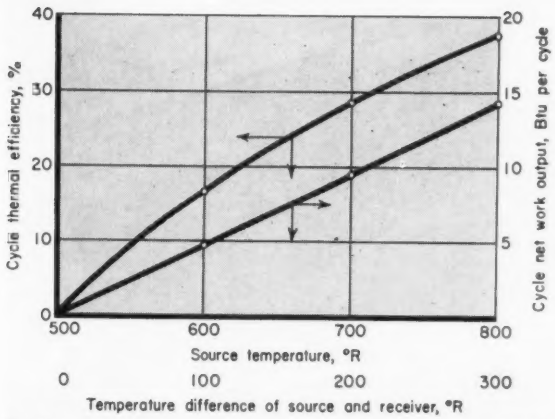
Since W_3 equals Q_s we can get some idea of the efficiency by comparing W in Fig. 6 with W_3 in Fig. 4. For the relative temperatures chosen we can see that W is only a small part of W_3, so thermal efficiency is well below 100%.

Let us find out what controls the thermal efficiency of an ideal cycle. In Fig. 7 we choose constant-T lines T_r, T_1, T_2 and T_3 and plot a pair of adiabatic processes, AB for compression and CD for expansion. We choose a constant-T line T_r for rejecting heat to the receiver. The area underneath, W_r, measures the heat rejected from the cycle, which stays constant in the following discussion.

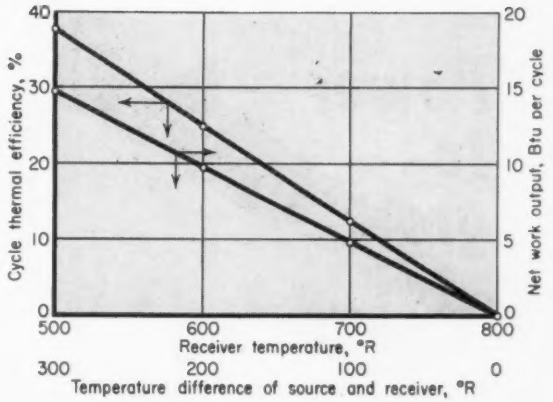
When we use a source with temperature T_1 we get net work W_a and heat rejection of W_r. Total heat input to the cycle $Q_s = Q_r + W_a$; this also equals the area under the T_1 curve.

Next, suppose we use a higher temperature for our source T_2 but the same receiver temperature T_r. We then get a larger net $W = W_a + W_b$ but the same $Q_r = W_r$. Then $Q_s = Q_r + W_a + W_b$. Since $e_t = W/(W + Q_r)$ and W increases, the efficiency must increase.

If we raise source temperature further to T_3 we get the additional net work W_c so that $W = W_a + W_b + W_c$.


Cycle thermal efficiency, %
Cycle net work output, Btu per cycle
Source temperature, °R
Temperature difference of source and receiver, °R

8 For constant receiver temperature both cycle thermal efficiency and work output rise with source temperature


Cycle thermal efficiency, %
Net work output, Btu per cycle
Receiver temperature, °R
Temperature difference of source and receiver, °R

9 For constant source temp both the cycle thermal efficiency and work output decrease with rise in receiver temp

Table 1: Performance of three Carnot cycles with common receiver temperature of 500 °R, all using one lb of air as the gas

Cycle	State	P	V	T	$W_r = Q_r$	$W_s = Q_s$	$W = Q$	e_t	Q/T
	1	15.0	12.34	500	23.73				0.04747
	2	30.0	6.17	500					
A	3	56.75	3.91	600		28.48	4.75	0.1666	0.04747
	4	28.40	7.82	600					
B	3	97.4	2.66	700		33.23	9.50	0.2860	0.04747
	4	48.7	5.32	700					
C	3	155.4	1.91	800		37.98	14.25	0.3751	0.04747
	4	77.4	3.83	800					

Since Q_r does not change, we have further raised the thermal efficiency of the cycle.

This demonstrates one important principle: As the source temperature increases and the receiver temperature stays constant, the thermal efficiency increases. In fact, we aim to show that the efficiency of a heat engine depends primarily on the temperature of the source from which it receives heat energy and the temperature of the receiver to which it rejects unusable energy.

A second important principle we learn from the Carnot cycle: With average available receiver temperatures around 60 F (river, lake, ocean, atmosphere) it is impossible for a heat engine to completely convert all heat energy received into net work energy output. Some heat energy must always be rejected (as unavailable for conversion to work) to the receiver.

Temperature influence. Let's study three cycles all based on a common constant-T heat rejection process as suggested by Fig. 7. We will use state numbering *1-2-3-4* as in Fig. 6. Table 1 shows the results. The reversible adiabatic compression *2-3* and expansion *4-1* cancel each other as far as work energy is concerned and we can ignore them in our analysis.

Remember all properties are related by the basic gas equation $PV = RT$. States *3* and *2* and states *4* and *1* are related by $P_1V_1^k = P_2V_2^k$ the adiabatic gas equation. We assume our gas is air with $k = 1.4$, ratio of specific heats. This equation can be thrown into the form $T_1V_1^{k-1} = T_2V_2^{k-1}$ by substituting for P from the basic gas equation. The works for the two constant-T processes in each cycle are figured from the corresponding equation; $W = (P_1V_1/J)\log_e(P_1/P_2)$.

Table computations were started by assuming a state *1* of 15.0 psia and 500 °R and compressing to a state *2* of 30.0 psia and 500 °R. All the other values were figured from these as a base with a slide rule. You can check them with the above formulas to get exercise in understanding the principles and equations involved.

All three cycles *A*, *B* and *C* use the same receiver temperature and compression process at 500 °R. This always rejects 23.73 Btu per lb air per cycle for all cycles. Cycle *A* with a source temperature of 600 °R injects 28.48 Btu per lb air per cycle and produces a net output of 4.75 Btu for a thermal efficiency of 16.66%. Cycle *B* with a 700-°R source injects 33.23 Btu for a net output of 9.50 Btu at a thermal efficiency of 28.60%. Cycle *C* with 800-°R source injects 37.98 Btu for a net output of 14.25 Btu at an efficiency of 37.51%.

Fig. 8 summarizes this data. It shows that the net work is directly proportional to the source temperature when receiver temperature stays constant, or directly proportional to the temperature drop through which the cycle operates, that is:

$$W = Q = C(T_s - T_r)$$

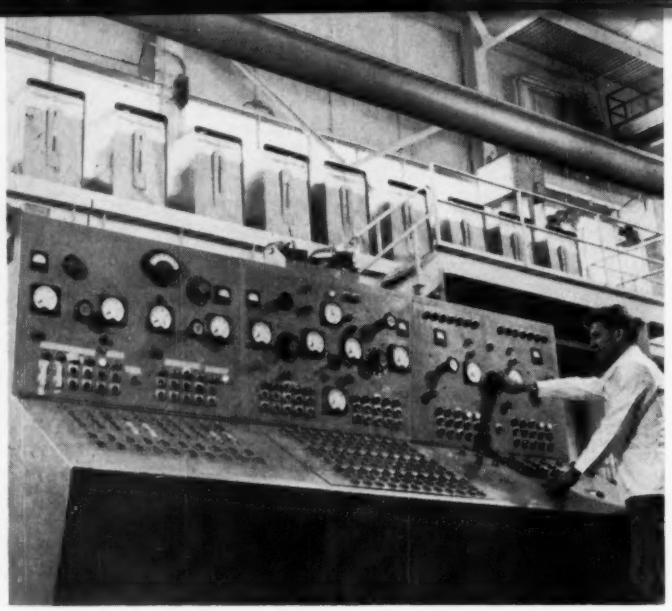
where C is a proportionality constant. Thermal efficiency of the cycle also rises with temperature differential, showing the advantage of using a high temperature where practicable.

Receiver temperature. Let's see what effect a variable receiver temperature has on cycle performance. We will assume we have a constant source temperature of 800 °R and use the series

(*Continued on page* 230)

Power to grow ...electrically

NO. 10: LOADING



REMOTE CONTROL of titanium melting operation is handled from this point. Rectifiers, spotted above furnaces, keep low-voltage runs to minimum

A rough furnace load can play hob with any electrical system. So before pinning down figures for capacity, growth needs, probe load characteristics carefully

Tough loads? Be sure of your PTG footing

► INDUSTRIAL FURNACES can pose knotty electrical distribution problems. This is especially true in the newer metal industries where processing techniques are still on the steep part of the growth curve. A straight 3-phase furnace can be designed into a system with little head scratching. But if the process calls for single-phase or even dc furnaces, keep your eye peeled.

Dc applications throughout industry are on the upswing; not only among the big steel and aluminum users, but across-the-board in general. One big reason for this growth is to meet the degree of speed variation that can be had only with dc motors. For run-of-mill dc needs, power-service engineers follow the proven load center scheme, spotting conversion units at these points. (POWER, Oct 1953, pp 120-121; May 1957, pp 134-135). In such cases, actual rectifying equipment follows the modern packaging theme. For any sizable applications the rectifier package is a full-fledged unit sub with an ac circuit breaker, stepdown transformer, dc conversion units, dc main breaker and smaller feeder breakers.

But where arc melting is involved there are several PTG angles to scrutinize before cementing final plans.

Case-in-point is found in the Mallory-Sharon titanium plant, Niles, Ohio. As pointed out by Mallory-Sharon's electrical engineer W H Gorga, titanium production poses a unique problem in melting and processing. Titanium has a high melting point and at these high temperatures the base metal is innately fond of oxygen, hydrogen, nitrogen, plus other gases. Even small amounts of these impurities in the finished product can render it practically useless. It's these troublesome properties that are responsible for most of the exact melting and fabricating methods undertaken to get the finished product.

To more fully appreciate the electrical problem, let's look for a moment into the techniques of titanium processing. Titanium undergoes three basic steps from ore to finished product: (1) sponge manufacture (2) melting into ingots (3) fabricating into a mill product. Mallory-Sharon is concerned with melting and fabrication.

Titanium production starts with reducing titanium tetrachloride to separate pure titanium sponge. This is a batch process with energy needs running about 15 kwhr per lb of sponge. Titanium sponge is then melted into ingots. After some preliminary steps, the sponge briquets are assembled into consumable electrodes and fed into the arc melting furnace.

Most melting is done with a single electrode, much like a giant welding process. Because of similarity to a welding process and the fact that it is basically a single-electrode operation, a dc power supply has been used. When the titanium industry was in its infancy, voltage characteristics and current needed for melting were very applicable to welding equipment. So power supplies were usually rotating dc welding generators. It was common to parallel a large group of welders and use them for power supply.

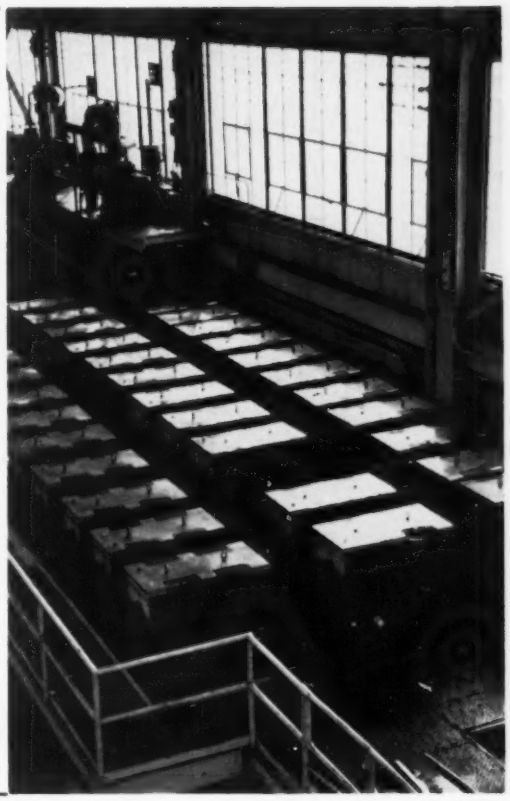
As the titanium industry grew and current needs increased, it became more difficult to parallel and control large numbers of these units. Therefore, a rather complicated control system was needed to effectively parallel large numbers of welding m-g sets. Also, a common source of dc excitation was needed. Naturally, each unit had its individual dc overload relay and contactor with interlocking relays. So if a generator field opened in any welding generator,

A look at titanium

Power to grow is an important consideration throughout Mallory-Sharon's electrical picture, one phase being the rectifiers atop furnaces, *right*. In recent months, Mallory-Sharon facilities have been expanded to boost melting capacity to 6000 tons annually.

Where will titanium find its biggest market? In the near future the aircraft industry alone will gobble up 150,000 tons yearly. Couple this figure with the needs of other industries and, using Mallory-Sharon's figures, the total may come to more than 200,000 tons yearly.

Then, since about 20 kwhr are needed to produce a finished pound of titanium, the annual electrical tally to produce this amount of titanium comes to 8-billion kwhr, a sizable chunk of energy.



that unit would be taken off the line. Also, each unit contained a time delay relay in its control circuit to insure the generator-drive motor reaching full speed before contactor closed on bus. The maintenance problem was a big reason for the industry seeking a power supply other than m-g sets.

Ac melting was tried. Although titanium could be melted with ac, many new problems cropped up in this single-phase operation. First, the power company wouldn't deliver large single-phase blocks of power. Second, price of m-g sets to get single-phase power proved more costly than straight rectifier equipment. Third, the dc arc has certain characteristics making it easier to control. All these factors added up to the bald fact that until a refractory was designed to handle molten titanium without excessive contamination, the 3-electrode configuration for 3-phase melting couldn't be used. So thinking shifted back to dc equipment as more desirable for titanium melting.

It was at this point, according to engineer Gorga, that rectifiers were considered as a dc power supply. Having gone to the welding manufacturers for the original power supply, the titanium people again turned to them to supply rectifiers.

Now, because of larger loads, it was increasingly difficult to use standard welding equipment. Production required too many units needing valuable space. So it became necessary for the welding manufacturers to develop a special unit just for titanium arc melting. This proved a toughie since the welding-rectifier makers were used to operating on a 60% duty cycle, largest machine being 600 amp. Now they were getting demands for still bigger machines. Largest unit obtainable at that time was 1000 amp at a 100% duty cycle (selenium rectifier) and 2000 amp (germanium rectifiers) with primary voltage 220/400.

Actually, rectifiers are more suited than those of m-g sets for titanium melting, especially under short-circuit condition. M-g sets supply 500 to 600% overload on a short circuit while a welding rectifier seldom exceeds 180% of rated current. So selenium and germanium were tried for arc melting. By comparing efficiency and volt ampere curves of selenium and germanium at 40 v, the selenium showed an efficiency of 65 to 75%; germanium 80 to 90%. Selenium rectifiers have a drooping characteristic — common for most welding equipment. These are air-cooled 3-phase 460-v 60-cycle 1000-amp continuous-duty units. Germanium rectifier units have a drooping characteristic with a constant current output, regardless of applied voltage.

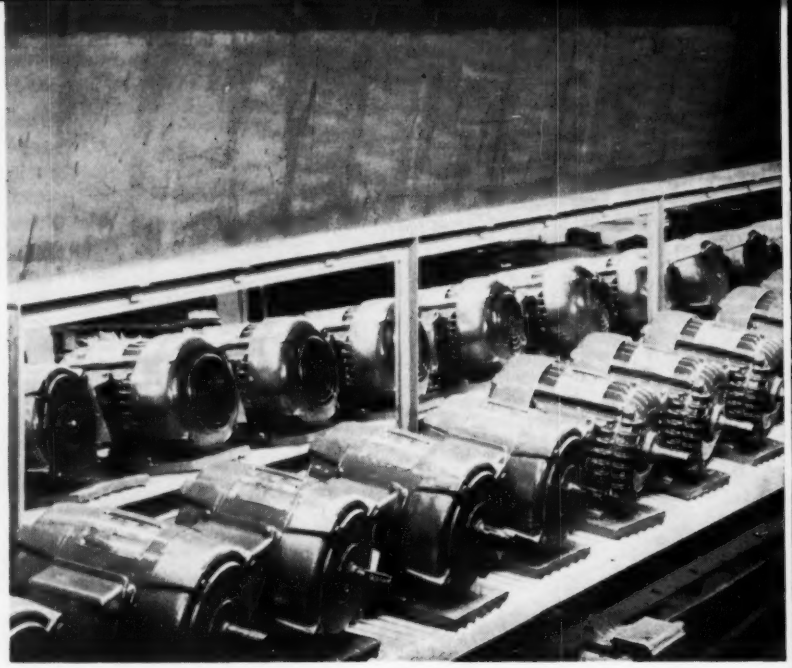
While these 1000- and 2000-amp rectifiers are OK now, as titanium progresses and the industry starts making larger-sized ingots, it will be looking for better means of power supplies for their arc-melting furnaces. Electrical manufacturers, according to engineer Gorga, have been slow in developing a suitable power supply for titanium melting. Present practice calls for paralleling many 1000-amp units together.

Titanium sheets are annealed in an electric furnace and given a cold-roll pass to flatten; then they're conditioned tested, inspected, readied for shipment.

Electrical energy needed in the annealing phase of processing is 2.75 to 3 kwhr per lb of titanium. This demand will increase as the industry converts from gas to electricity for heating titanium. There are decided metallurgical advantages in electric heating, compared with direct-gas heating.

By R F WOLL
Motor and Control Division
Westinghouse Electric Corp

There is always a true need for specials. But too often the power-service engineer fails to consider all angles before specifying a non-standard motor. It all boils down to these factors . . .



STANDARD squirrel-cage motors, mass-produced at lowest cost, have . . .

Cost, availability, delivery date:

► IT'S NO LONGER a simple job to determine whether a motor is truly standard or a special. Reason: Present-day standards for integral hp induction motors include a wide variety of electrical and mechanical characteristics.

Transition from basic to specials is generally accompanied by a three-pronged headache to any power-service engineer: (1) higher cost (2) longer delivery time (3) fewer supply sources. One useful criterion as to whether or not we are dealing with a truly standard motor is the extent to which these headaches are present. To the motor supplier there is another factor that is all important and upon which the other factors depend—sales activity. Large demand for any product that can be built for sale at a profit creates standards, in time transforming the once special item into a standardized commodity.

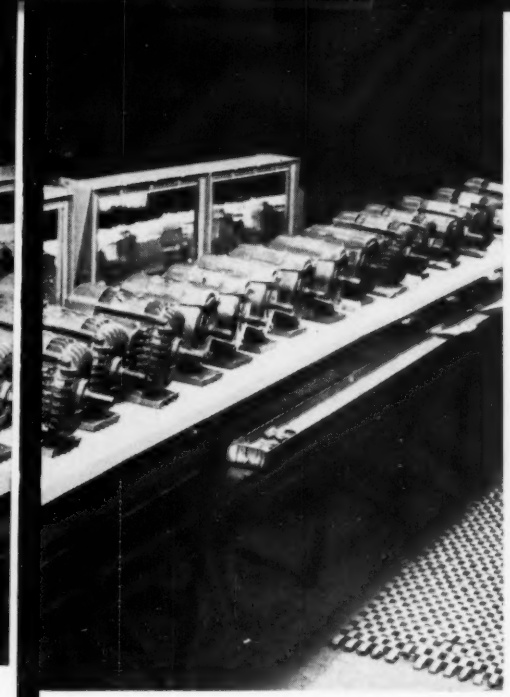
Possible combinations of motor characteristics border on the astronomical. In addition there are many varieties that are standardized to some extent and manufactured in substantial quantities: loom motors, sanitary motors, general-purpose and crane and hoist wound-rotor motors. Also there are textile motors designed to resist clogging in lint-laden atmospheres, built-in motors, gear motors, hermetic motors, synchronous-induction motors, multispeed motors, plus many others. So in the broad range of standard motors available, there are several suitable for most specific applications. Your problem is to determine which of these many standard motors is the one to use. You try to make a compromise between motor design and machine design so overall design is the most economical.

Standardized hp ratings are today taken for granted in the U.S. Yet only recently, European motor manufacturers established rating standards. Their prior practice was to design, build and price each motor according to the precise rating specified by the customer. Although this permitted economies in utilization of active material and is economical in the sense that the user specifies and obtains only as much as he needs, it makes lavish demands on technical manpower and tends to increase the variety of component parts needed. User must finally underwrite whatever increased costs these factors entail.

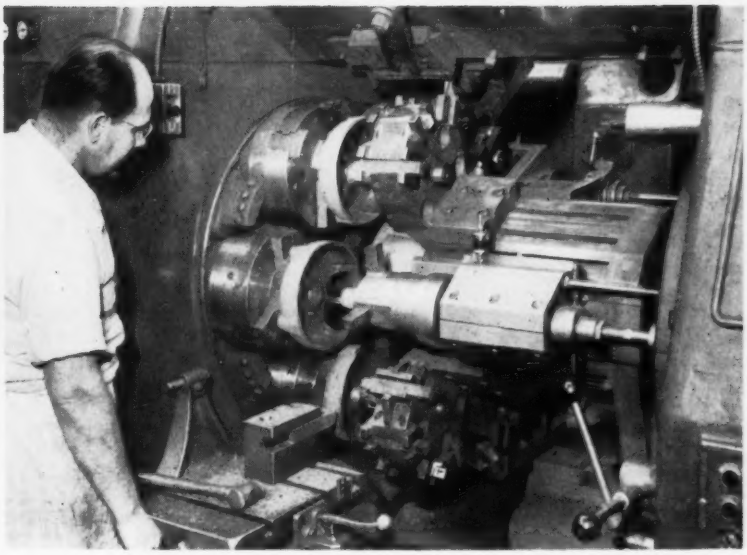
Hp ratings afford you little choice. Motor must be rated equal to the application. But there is no need to use a larger motor than the next standardized rating above the load requirement. Actually where the requirement is only slightly above a standardized hp rating, it is often OK to use a motor of that particular rating. As a basis for this statement, the operating temperature—upon which is based insulation life expectancy—is premised upon an ambient temperature of 40 C. This level is not attained in many installations. And for open general-purpose motors rated at 40C rise, a service factor provides for added load that may be safely carried beyond the nominal nameplate rating. Size of service factor varies with hp rating. For motors rated 1 hp or less, the *sf* is 1.25; for motors rated at 1½ or 2 hp, it is 1.20; and for motors rated 3 hp or above, 1.15. Further economies can be realized by taking advantage of low ambient temperatures in addition to the latitude afforded by service factor.

Motor frequency is dictated by the power supply. In aircraft and shipboard installation, 120 or 400 cycles are used to get more power per unit weight. In other special applications, for example run-out tables in steel mills, variable frequency gives varying speed.

To attain greatest motor hp per dollar of investment, use the highest possible motor speed. This is usually not less than 1200 rpm, as in a six-pole motor operating at 60 cycles. However, since 3600-rpm motors are frequently



proven to be industry's real wheel-turners



MACHINING brackets for standard motors is done six-at-a-clip

The case for buying standard motors

too tough on belting, gearing and machine elements, 1800-rpm 4-pole motors are the most popular today.

Slower-speed motors, running 900 rpm and below, are larger and more expensive for a given rating. Slow-speed motors in small frame sizes call for careful design and manufacture to avoid objectionable noise, low efficiency, low pf and low torque. Yet slow-speed motors are well-suited for frequent starts, plug stops or plug reversals. Reason: Motor losses during such speed changes are proportional to the square of synchronous speed.

Phases and voltage are also dictated by the power supply. Within the 1- to 30-hp range, any of the listed voltages are practical. However, certain problems are met in designing 550-v motors in lowest ratings and 110-v motors in highest. In the former, the large number of turns required compel the use of extremely small wires for the stator windings; in the case of large 110-volt motors, the wire used is quite heavy, calling for additional manufacturing expense. Basic voltages today are 220 and 440 with induction motors designed to operate satisfactorily within $\pm 10\%$ of that rated voltage.

Selecting the best electrical design for a specific job represents a most important area. Basic operating characteristics for each design classification are tabulated, p 98, together with a description of the principal applications for which they are intended. Note that Designs *A* and *B* are the truly standard motors. Well adapted to the majority of industrial applications, they are built in great volume, priced lower, most frequently stocked, are more widely available from a number of suppliers than are the other design classifications. Unless the application clearly calls for one of the other design classifications, use a Design *A* or *B*.

Designs *A*, *B*, *C* and *F* are rated for continuous duty. While a motor rated specifically for intermittent duty may cost less, particularly if it is supplied on a smaller than standard frame, it will definitely be a special motor and subject to their disadvantages.

Design *D* motors may carry time ratings of 1/12 hour (valves), ¼ and ½ hour cranes and hoists) or continuous duty (punch presses and tapping motors). Generally speaking, any Design *D* motor is inherently special. Obtaining a time rating different from normal increases the degree of specialty but is not usually a serious problem.

Three standardized insulation classes are used in induction motors corresponding to the limiting internal operating temperatures: Class *A* for hot-spot temperatures of 105 C, Class *B* for 130 C, and Class *H* for 180 C (POWER, Oct 1953, p 114; June 1955, pp 82-85).

Class *A* insulation is standard for induction motors. Although some manufacturers incorporate Class *B* or Class *H* insulation components in standard or near-standard lines, these two insulation classes are generally confined to special motors designed for unusual applications. Such applications might involve high ambient temperatures, motors on reduced frame sizes, severe duty cycles.

Proper enclosure depends upon motor location. Greater the protection required, the more expensive and less standard is the motor. Open dripproof motors are suitable and preferred for most commercial and many industrial installations. About two-thirds of all motors sold are open dripproof.

More popular standardized motor enclosures are tabulated, p 99, in approximate order of increasing cost. Some makers have dropped splashproof enclosures in the smaller sizes. Because of greater protection built into modern dripproof motors, these manufacturers recommend dripproof enclosures for normal splashproof applications. Thus with the range of splashproof narrowed and added protection afforded by totally enclosed types, need for splashproof enclosures has been virtually eliminated.

Standard electrical design classifications and typical applications

NEMA design	General operating characteristics: Locked torque	Breakdown torque	Locked current	Slip	Intended usage	Typical applications
A	normal	high	normal	low	Infrequent starts with relatively light starting load; long running periods at rated load with occasional peak loads of short duration; continuous operation at moderate overloads under certain conditions	M-g sets, fans, drill presses, lathes, pumps, grinders, conveyors, machine tools, slusher hoists, compressors
B	normal	normal	low	low		
C	high	low	low	low	Infrequent starts with relatively heavy starting load; long running periods at rated load; limited capacity for peak loads and overloads	Electric stairways, pulverizers, compressors, conveyors
D	high		low	high	Intermittent rated: frequent starts with heavy starting load and short operating periods	Cranes, hoists, winches, valves, elevators
					Continuous rated: light running loads alternating with frequent momentary peak loads; reversing service	Punch presses, tapping machines
F	low	extra low	extra low	low	Similar to Design B but where extra low locked current is necessary and low torques are acceptable; lack of torque margin restricts overload	

Electrical and mechanical variations for squirrel-cage induction motors

Horsepower: 1, 1.5, 2, 3, 5, 7.5, 10, 15, 20, 25 and 30

Number of poles (determines speed depending on frequency):

Poles	Synchronous speed in rpm: 60 cycles	50 cycles	40 cycles	25 cycles
2	3600	3000	2400	1500
4	1800	1500	1200	750
6	1200	1000	800	500
8	900	750	600	—
10	720	—	—	—
12	600	—	—	—

Phases: 2 and 3

Voltage: 110, 208, 220, 240, 416, 440, 480 and 550 in the common 60-cycle range

Electrical design classification: A, B, C, D and F

Time rating: 1/12 hr, ¼ hr, ½ hr, 1 hr and continuous

Insulation class: A, B and H

Mechanical enclosure

Open: Dripproof, protected, splashproof and weatherproof

Totally enclosed: Nonventilated, fan-cooled, waterproof, explosionproof and dust explosionproof

Frame size (depends upon what combination of previous characteristics is desired):

182, 184, 213, 215, 254U, 256U, 284U, 286U, 324U, 324S, 326U and 326S

Mounting: Standard foot mounting, C-flange for close-coupled pumps, horizontal D-flange mounting and vertical with P-base

Coupled with the standardization of frame sizes and their important mounting dimensions is the assignment of particular ratings to specific frames. Building any motor on a frame other than one of the ten standardized frame sizes is rarely done.

Building a motor on a standard frame, other than the one to which a particular rating is assigned, is a less serious problem. But it also has its drawbacks. Example: To use a smaller frame than standard, it may be necessary to use a Class *B* or *H* insulation. Also, poor performance can result from working electromagnetic materials beyond their normal range and bearing loading, and shaft stresses may be excessive. In using a larger frame, the big disadvantage is that you are paying for more motor than you need.

In integral horsepower sizes, the basic standard motors are horizontal foot-mounted types. But modifications such as conduit box on side opposite or with brackets for wall or ceiling mounting are easily accommodated. For the latter, if the motor has vent openings in the frame, the additional problem of keeping these frame openings dripproof is encountered.

Somewhat more special are the standardized *C*, *D* and *P* flange mountings. The *C* flange is intended for mounting a relatively lightweight drive on the motor, such as a close-coupled pump. The *D* flange is intended for face mounting the motor on a machine. The *P*

Typical motor enclosures and applications in commercial buildings, industrial plants

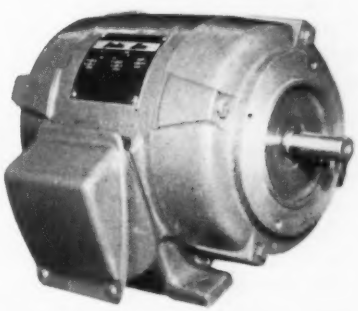
Enclosure classification		Description and usage	Typical installations
General	*Specific*		
Open	Dripproof	Ventilation openings designed so liquids or particles falling from above at an angle of 15 deg from the vertical cannot enter. Intended for clean, indoor areas where dripping or falling material comes essentially from directly overhead. Certain amounts of dirt, dust, etc can be tolerated provided the material is not conducting or severely abrasive or corrosive	Well kept machine shops, clean factories, stores, warehouses, laboratories, office buildings, garages and repair shops, central stations, elevator penthouses, separate motor rooms in steel mills, etc
	Splashproof	Design requirements and usage similar to dripproof except angle of protection extended to 100 deg from the vertical. Intended for use in areas where splashing liquid or mild hosing is encountered. May be used outdoors	Food cleaning and processing plants, pump rooms, oil-well pumping stations, locks and dams, outdoor substations, sewage-disposal plants, municipal water plants, etc
Totally enclosed	Nonventilated	Designed with no ventilation openings so air is not exchanged freely between the inside and outside of the casing. Not cooled by any means external to the enclosure. For use in areas containing harmful amounts of dirt, metal chips or other material that might damage the motor should it get inside. Used outdoors and in areas where severe splashing or hosing beyond the scope of splashproof protection is encountered	Foundries, cement plants, sand and gravel pits, working areas in steel mills, areas in machine shops where metal chips and filings are abundant, ore mines, chemical plants, pulp and paper mills, manufacture or handling of abrasives, etc
	Fan cooled	Same as nonventilated, but cooled by a fan external to the enclosure but part of the motor	
Totally enclosed (cont)	Explosion-proof	Used in areas containing explosive vapors. Design similar to nonventilated or fan-cooled, except casing must be strong enough to avoid rupture in the event of ignition of the explosive vapor inside the motor and the joints sealing the motor interior from the exterior must be sufficiently long and tight to quench the flame from such an internal explosion below the ignition point of the surrounding atmosphere	Manufacture and handling of crude or refined petroleum products
	Dust Explosion-proof	Used in areas containing hazardous concentrations of explosive dusts. Design similar to nonventilated or fan-cooled, except joints between motor interior and exterior must keep the explosive dust out of the enclosure, and surface temperatures under worst conditions of dust blanketing must not be such to ignite the dust	Machine shop areas with heavy concentration of magnesium or aluminum dust, coal mines, coal or coke conveyors, grain elevators, grain processing plants, etc

base mounts a motor vertically on a pump head. Thus standards exist for each of the more common mounting applications that go beyond the standard foot-mounted motor. A flange bracket differing from any of these standardized types would be classed as quite special.

Typical other special features are: special insulation—boiler house, tropical, insect repellent and fungus resistant; space heaters; shoe or disk brakes; zero speed switches; quiet-operating motors; special shaft dimensions or materials; special paint finishes; special conduit boxes or mounting; extra lead length; shock-resistant motors; rodent or insect screening; motors for use in high altitudes; special performance characteristics—higher torques, lower locked current, higher efficiency or power factor; and oversized bearings. Naturally, there are applications that require motors with some of these special features.

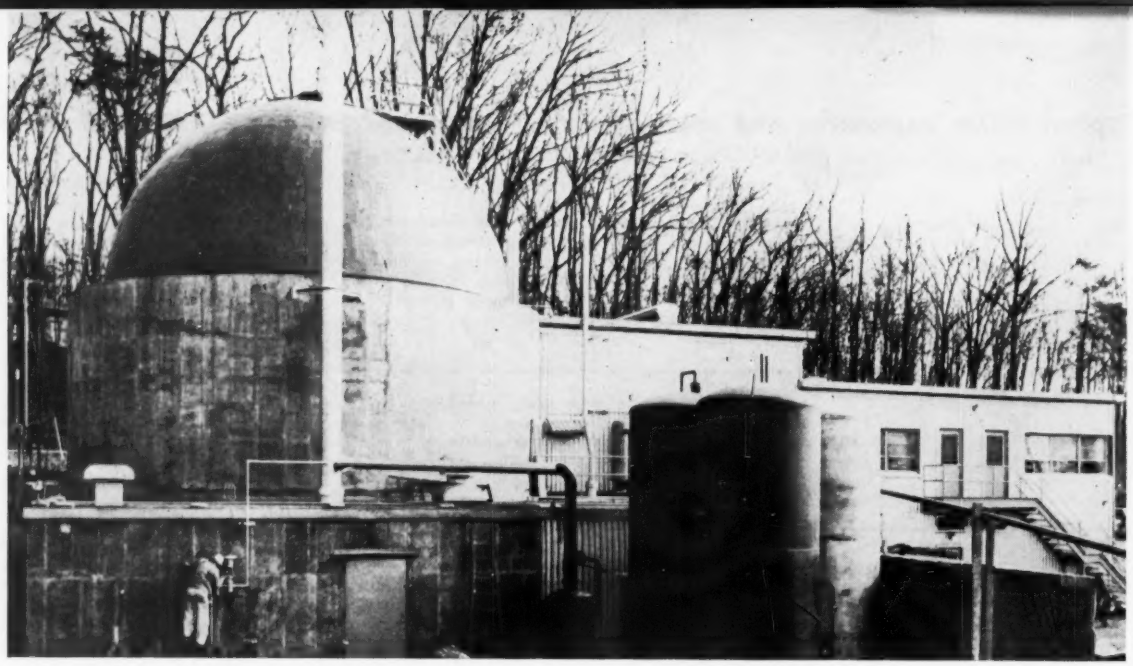
Salient advantages of off-the-shelf standard motors are price, delivery and multiple supply sources. An additional factor might well be quality.

In the area of price, it is a truism that any standard product will sell for less than a special item. For standard motors, their manufacture is a matter of high-volume production; there is a minimum of setup expense; paper work is less throughout; there are no special engineering or developing costs; shipping costs and sales expense are less. Singly, or in combination, these items are bound to result in a less favorable price for the special motor. And the more "special" the motor becomes, the higher will be its price. Unquestionably, a favorable price is a strong incentive for using a standard motor, but it is one you must evaluate carefully. To illustrate, if a special motor costs only $20 (*Continued on page* 236)



Dripproof motor . . .

. . . is fast becoming the basic unit for run-of-the-mill applications. Remember, all motors are either open or totally enclosed. Open designs have some form of enclosure; variations showing up in size, location, shape of vent openings. Splashproof enclosures are being abandoned by some makers in favor of dripproof designs. Table, above, lists typical motor enclosures and their uses.



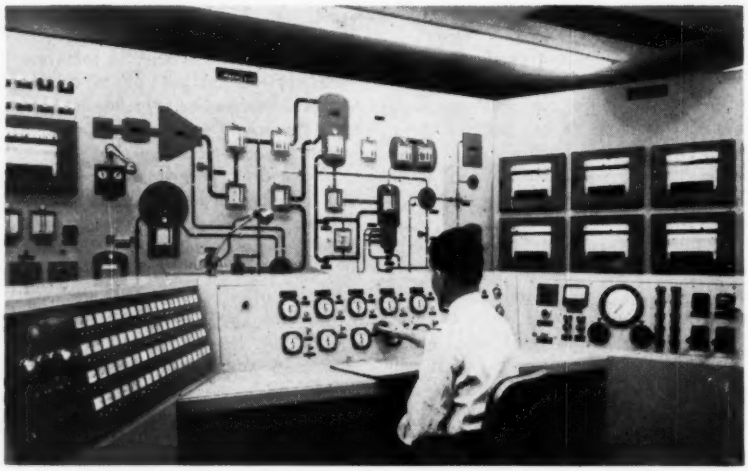
REACTOR WITH HEAT RATING of 10,000 kw and its 34,070-lb-per-hr boiler stand inside vapor container at left. Turbine-generator, condenser and heater of conventional design are in center building. Control room, offices, classroom for army trainees occupy building at far right. Water-storage tanks for some of seven water systems stand in foreground

APPR nuclear plant goes critical

Pressurized-water Army Package Power Reactor went through its preliminary tests during March 1957; 2035-kw plant can produce net 1855 kw

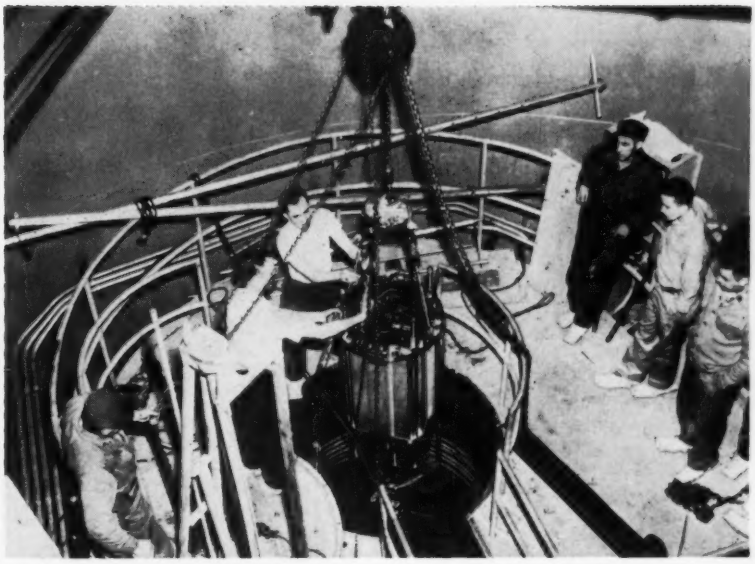
► THE APPR PLANT will be able to run 18 months on a single charge of uranium fuel that weighs only a few hundred pounds and is smaller than a barrel of oil. In the same time, a conventional plant of equal capacity will burn 60,000 barrels of oil, the load of a medium-sized tanker. Even under peacetime conditions, transportation savings to remote bases will probably counterbalance the greater investment cost of a nuclear plant.

Alco Products, Inc supplied reactor, pressurizer and steam generator of the APPR; Westinghouse Electric Corp supplied the canned-rotor pumps; General Electric Co supplied the turbine and generator; Lummus Co supplied the condenser and Minneapolis-Honeywell the controls.

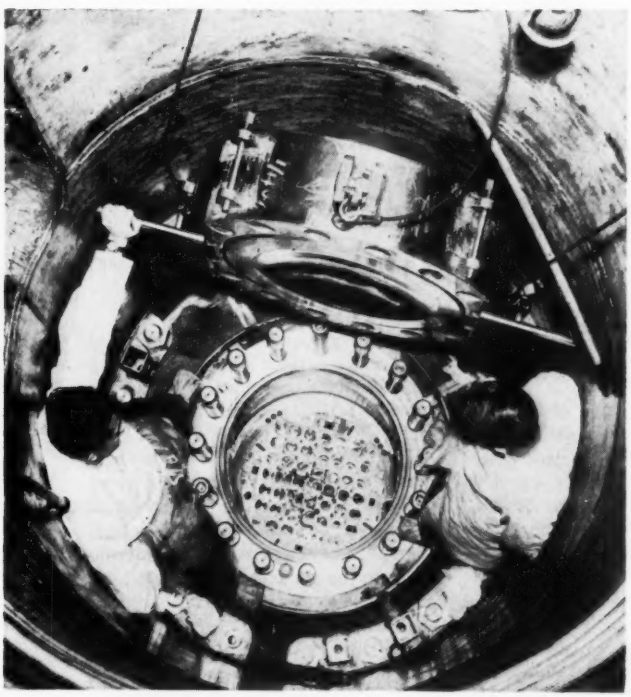


REACTOR PLANT CONTROL ROOM includes conventional instruments and remote or automatic controls for steam and electric plants. Reactor controls include duplicate channels for start-up, one channel covering six decades of neutron flux up to full power, one linear channel for power level, three safety channels that scram the reactor if any two read high. Normal operation will need total of 29 men. Operators will be high-school grads with 1-yr training, led by engineers

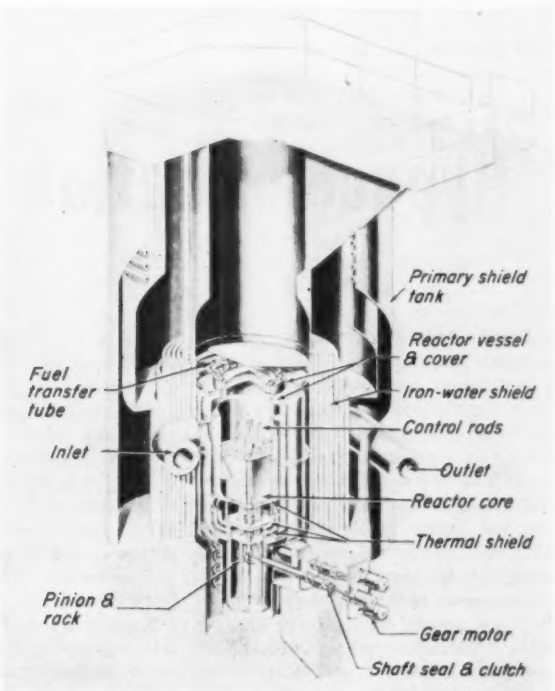
REACTOR VESSEL of APPR is installed by lowering through opening in top of vapor container. Reactor core has an average heat transfer of 55,900 Btu per hr per sq ft to water coolant at 1200-psia pressure, rising from 431 to 450 F



REACTOR CORE STRUCTURE being lowered from working platform inside vapor container to reactor vessel below, measures 22.2-in average dia and 22-in. high. When changing fuel elements, operators will stand on this platform and handle elements with tongs. Well above reactor core will be filled with treated water to within few inches of working platform. This depth of water will shield operators from lethal radiations emitted by spent fuel elements, but lets men see fuel core

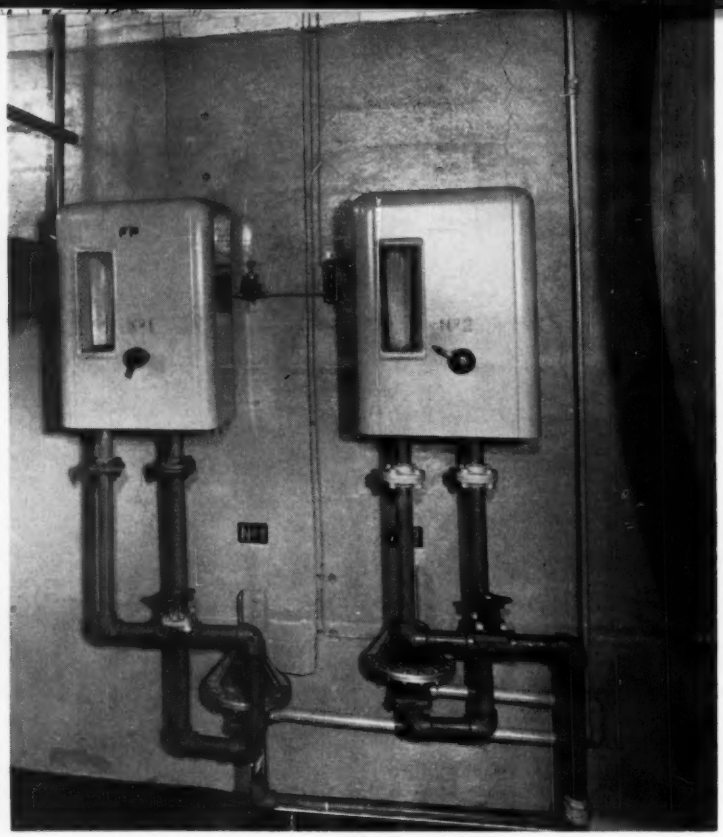


READY FOR FUEL ELEMENTS, core structure inside reactor vessel has 7x7 array with corners missing. It holds 38 fuel elements of fully enriched uranium dioxide and 7 control rods. Each element has 18 fuel plates brazed into a pair of stainless-steel side plates 27-in. long, 2.86-in. wide, 0.005-in. thick. Control rods have both fuel and absorber sections



SHIELDING FOR APPR uses concentric iron and water sections to reduce need for concrete which may be hard to obtain or transport to remote locations. Control rods are driven from bottom of core through rack and gear arrangement. They can be serviced without shutting down reactor. Cooling water flows through pipe in tank to remove heat from shield

By **JAMES D SPRINGS**, *Test Engineer*
The Narragansett Electric Company
Providence, Rhode Island



HYPOCHLORINATORS replace pneumatic type gaseous chlorinators formerly used. Each unit feeds up to 25-gpm sodium hypochlorite to the condenser cooling water

Increased safety plus lower operating costs explain why this utility switched from chlorine gas to . . .

Hypochlorination for slime control

► HYPOCHLORINATORS, above, control condenser cooling-water slime at two of our Providence generating stations. These installations followed more than four years of research and testing to find a suitable hazard-free disinfecting agent. Two years' operating experience with hypochlorination prove that it is safe and just as effective as gaseous chlorine. In addition, operating and initial costs are lower.

Condenser cooling system. Three 40,000-kw generating units are operating at the Manchester Street plant. The first unit (430,000 lb per hr steam at 1200 psig, 915 F) is equipped with a single-pass surface condenser supplied by either one or two 35,000-gpm circulating-water pumps.

Single-pass surface condensers also serve the other two 40,000-kw units (450,000 lb per hr steam at 120 psig, 950 F). Each condenser is rated at 60,000 gpm and both are fed by three circulating-water pumps.

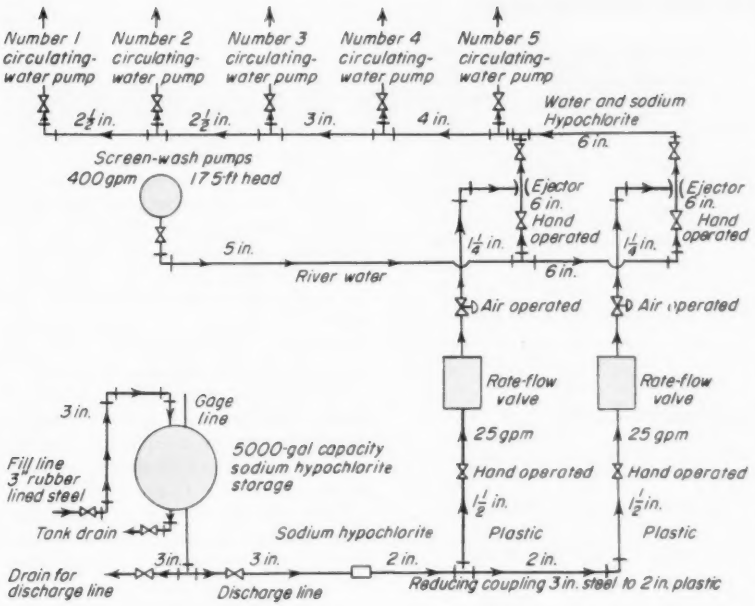
Any desired combination of the five circulating pumps is possible through a system of crossovers and valves.

The South Street station, about 300 yards upstream, has two 45,000-kw units. Single-pass surface condensers are now used in place of the original jet condensers. Each unit is supplied by two 35,000-gpm pumps.

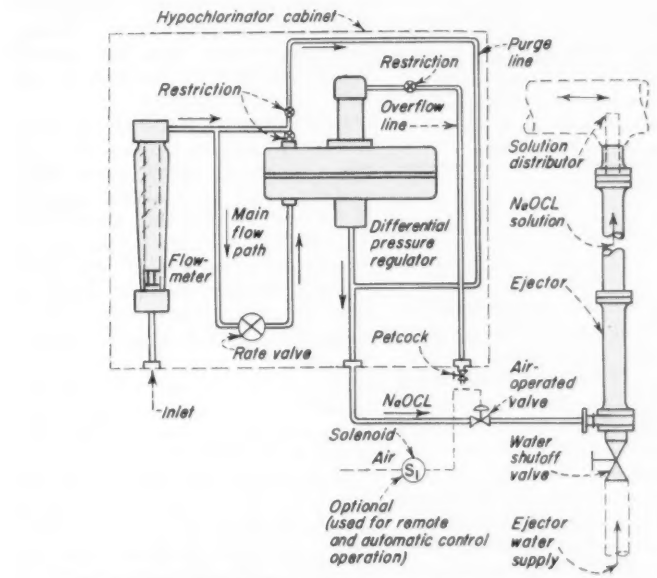
Cooling water for both stations is taken from the Providence River. At the power plants it contains 14 to 57% sea water depending on the tide. Although our experience is limited to this sea water, other generating stations in our area are having equally good results with hypochlorination on fresh-water sources.

Gaseous chlorine. Prior to the changover, gaseous chlorine controlled slime in the surface condenser cooling water. After consultation with the Chlorine Institute, maximum chlorine residual was fixed at 0.5 ppm. Chlorination program was set up to feed enough chlorine for 12 minutes every two hours to produce 0.5 ppm residual chlorine in the condenser discharge. This was low enough to prevent chlorine attack on the condenser tubes and high enough to control organisms causing tube fouling.

Original hydraulically controlled chlorinators needed excessive maintenance and were replaced with pneumatically controlled units. These newer chlorinators did reduce maintenance but still required a lot of attention. The hazards associated with chlorine gas were always present. Several cases of leakage that might have been dangerous



CIRCULATING-WATER SYSTEM at Manchester Street station. Ejectors fed by screen wash pumps deliver dilute hypochlorite solution to circulating-water pumps



HYPOCHLORINATOR uses differential pressure regulator to maintain constant flow at any given rate set valve position

served to emphasize the problem. We decided to investigate other disinfectants to replace chlorine gas.

Two chlorine sources compared. Is sodium hypochlorite as economical and effective as chlorine gas for slime control? Laboratory tests were started in 1951 to find the answer.

First step was to find out if the chlorine demand of the water was equal to equivalent dosages from each chlorine source. Individual solutions of chlorine water and sodium hypochlorite, each having about the same amount of available chlorine, were added separately and in varying quantities to isolated samples of raw cooling water. Residual chlorine was determined immediately and again after a thirty minute contact period. Each test series was completed within a few days with water temperature remaining constant.

Typical results are shown in chart, page 104. Sodium hypochlorite and chlorine gas are equally effective below break-point concentrations with equal amounts of available chlorine.

Relative cost. Tests proved that sodium hypochlorite is satisfactory as a source of chlorine. But what about its high cost?

Operating records showed that the water often has a chlorine demand up to about 8 ppm. Occasionally it is as high as 10 ppm because of hydrogen sulfide in the water after prolonged hot, dry spells. Average demand is about 6 ppm.

When feeding chlorine gas for 12 min every 2 hr the daily cost is $46.80 for a total cooling water flow of one million lb per min. Sodium hypochlorite cost for this same program is $112.30 per day. Chlorine residual in both cases is 0.5 ppm.

How can this wide difference in operating costs be reduced? Only way to make any sizable reduction is to develop another treatment program that uses less total chemical. Since sodium hypochlorite is stabilized with caustic, a much higher chlorine residual can be carried without harming the condenser tubes. It was tentatively decided to try 10 ppm chlorine residual with a feed program of 30 min every 24 hr.

We hoped that increased concentration and longer contact time would offset the overall decrease in the amount of hypochlorite used. Later test results showed this to be true. Fouling organisms were kept under control just as effectively as with chlorine gas.

Chart, page 104, compares the treatment cost of chlorine gas and sodium hypochlorite programs. With program I for hypochlorite, the cost is reduced to $57.60 at the average demand of 6 ppm.

Hypochlorite equipment. Following the test work on effectiveness and relative cost of sodium hypochlorite, hypochlorination was put into operation on a trial basis at the Manchester Street station. A standard chlorinator was taken out of service at the plant. Sodium hypochlorite was then fed into the injector of this chlorinator. An existing pump supplied water under pressure for the injector. Condenser cooling water was hypochlorinated with this equipment for many months. Results were entirely satisfactory.

We wanted to convert to hypochlorite use exclusively at both generating stations. But the problem was to find a good method of adding a controlled

Effective of chlorine gas and hypochlorite

Liquid chlorine (gas)			Sodium hypochlorite		
ppm added	ppm residual	ppm demand	ppm as Cl_2 added	ppm residual	ppm demand
1.04	0.05	0.99	—	—	—
1.56	0.17	1.39	1.90	0.20	1.70
1.91	0.27	1.64	2.0	0.20	1.80
2.10	0.28	1.82	2.14	0.28	1.86
2.60	0.42	2.18	2.26	0.35	1.91
3.12	0.63	2.49	2.36	0.32	2.04
3.82	0.87	2.95	3.49	0.51	2.98
4.20	0.75	3.45	4.10	0.80	3.30

Comparison of treatment costs

Chlorine demand ppm	Chlorine gas Cost in $/day	Sodium hypochlorite cost in $/day	
		Program I	Program II
0	3.60	36.00	18.00
1	10.80	39.60	21.60
2	18.00	43.20	25.20
3	25.20	46.80	28.80
4	32.40	50.40	32.40
5	39.60	54.00	36.00
6	46.80	57.60	39.60
7	54.00	61.20	43.20
8	61.20	64.80	46.80
9	68.40	68.40	50.40
10	75.60	72.00	54.00
Rate program cost basis	0.50 ppm residual 12 min every 2 hr 5¢ per lb	10.00 ppm residual 30 min every 24 hr 12¢ per lb available chlorine	5.00 ppm residual 30 min every 24 hr 12¢ per lb available chlorine

amount of hypochlorite to the condenser cooling water. Positive displacement pumps were a possibility but experience with them at the South Street station was unsatisfactory. Excessive maintenance was needed to insure reliable operation. It was decided to explore the feasibility of developing special equipment to handle and accurately control feed rate of the corrosive hypochlorite solution under our known operating conditions.

With the cooperation of Fields Point Manufacturing Company and Fischer & Porter Company, an experimental model hypochlorinator was constructed and put under test at the Manchester Street station. It was first put into operation on August 31, 1954. On this memorable day Hurricane Carol swept through Providence. The river flooded both stations and knocked out the gaseous chlorination equipment. But the hypochlorinator continued operating without any interruption.

We decided to replace the damaged chlorinators with two hypochlorinators. This equipment was installed in 1955 and has been comparatively maintenance free. Positive displacement pumps at the South Street station will also be replaced with hypochlorinators of this same type.

Hypochlorinator operation. Schematic diagram of the hypochlorinator is given on page 103. The various controls are enclosed in a molded fiberglass case. Ejector and air-operated shutoff valve are mounted externally. Control elements include a glass variable area meter, rate set valve and a differential pressure regulator. The external ejector assembly is normally used to obtain good mixing of chemical and in this case circulating water.

When the rate set valve is opened, hypochlorite flows up through the variable area meter and positions the meter float. From the top of the meter this liquid flows through the rate set valve into the bottom of the differential pressure regulator. It then flows through the automatic shutoff valve to the ejector for mixing with water from the screen wash pumps.

Small line from the top of the meter, ahead of the rate valve, transmits inlet liquid pressure to the top of the differential pressure regulator diaphragm. The top chamber is purged continuously through a small line connected to the outlet. It can also be vented through the overflow line and petcock. But for normal operation this line is closed.

Differential pressure regulator is parallel with the rate valve. It operates to maintain a constant flow of chemical through the hypochlorinator at any given rate valve position.

Let's assume that at a given rate valve setting, changes in pressure conditions tend to increase flow through the system. Any increase in pressure is automatically transmitted to both the top and bottom side of the regular diaphragm. Pressure drop across the rate valve remains the same. Net result: Original position of the valve plug maintains the desired flow of chemical through the hypochlorinator. Similar action takes place when flow through the system tends to decrease at any given rate valve setting.

Hypochlorinator is placed in operation by first opening the rate valve and the air-operated shutoff valve. Then vent the system by opening the petcock in the overflow line until liquid flows out. Set the rate valve for the desired flow by using the variable area meter.

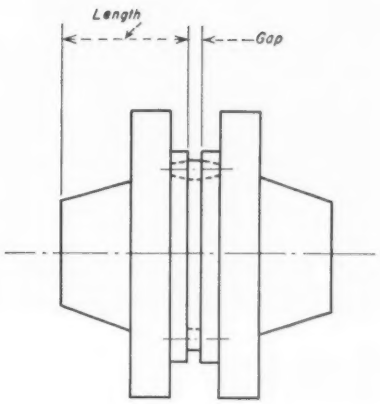
Lower residual chlorine. Early in 1956, we explored ways of further reducing the cost of hypochlorination. We decided to lower the chlorine residual from 10 to 5 ppm while keeping up the same treatment program. Chart, left, compares this cost with both program I and chlorine gas.

At the average demand of 6 ppm the daily cost of treating one million lb per min with hypochlorite is now $39.60. This is well under the chlorine gas cost of $46.80 and the previous hypochlorite cost of $57.60. Reduced cost of treatment with program II was obtained without any decrease in the effectiveness of slime control.

Low initial cost. Including storage facilities the total cost of the hypochlorinator installation is lower. Primary factor in the higher cost of chlorine-gas handling equipment is the high rate at which chlorine must be fed to satisfy the chlorine demand of the water. This rate requires at least one high-capacity chlorinator and a chlorine evaporator.

Power's DATA SHEET

No. 300



Dimensions of ASA ring-type joint flanges

Nominal size	300 psi		600 psi		900 psi		1500 psi	
	Length	Gap	Length	Gap	Length	Gap	Length	Gap
1	2 5/8	5/32	2 11/16	5/32	3 1/8	5/32	3 1/8	5/32
1 1/2	2 7/8	5/32	3	5/32	3 1/2	5/32	3 1/2	5/32
2	3	7/32	3 3/16	3/16	4 5/16	1/8	4 5/16	1/8
3	3 3/8	7/32	3 9/16	3/16	4 5/16	5/32	4 13/16	1/8
4	3 5/8	7/32	4 5/16	3/16	4 13/16	5/32	5 3/16	1/8
6	4 1/8	7/32	4 15/16	3/16	5 13/16	5/32	7 1/8	1/8

Note: All dimensions in inches

► CHECKING AND DIMENSIONING ring-type joint (RTJ) flanges is inconvenient and can lead to error because most catalogs have the needed data on different pages. Here all the needed data for the most common piping sizes are collected in one compact table. This has proven very handy and is a great timesaver as well.

JOHN DLOUHY, *San Mateo, Calif.*

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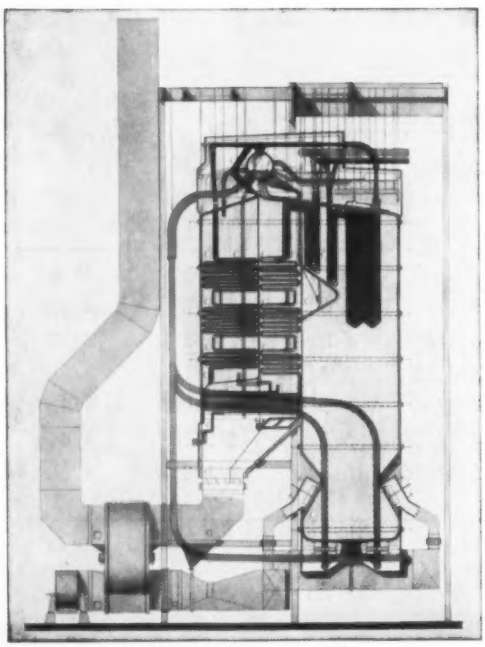
A record acceptance of a new boiler

19 RILEY BOILERS

In capacities from 150,000 lbs/hr to 1,600,000 lbs/hr



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Dallas Power & Light Co. — Northwest Steam Electric Station
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Texas Electric Service Co. — Permian Basin Steam Electric Station
1—825,000# — 1750 psig — 1005/1005 F — Gas & Oil

Florida Power Corporation — Enterprise, Florida
1—600,000# — 1750 psig — 1000/1000 F — Gas & Oil

Delaware Power & Light Co. — Delaware City Power Station
3—500,000# — 1425 psig — 950 F — Fluid Coke

Manila Electric Co. — Republic of the Philippines
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Chemical Company — Texas
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Chemical Company — Michigan
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1—500,000# — 1425 psig — 750 F — Fluid Coke

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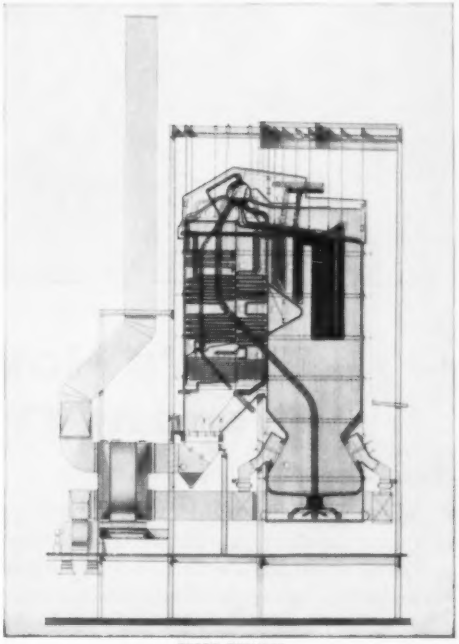

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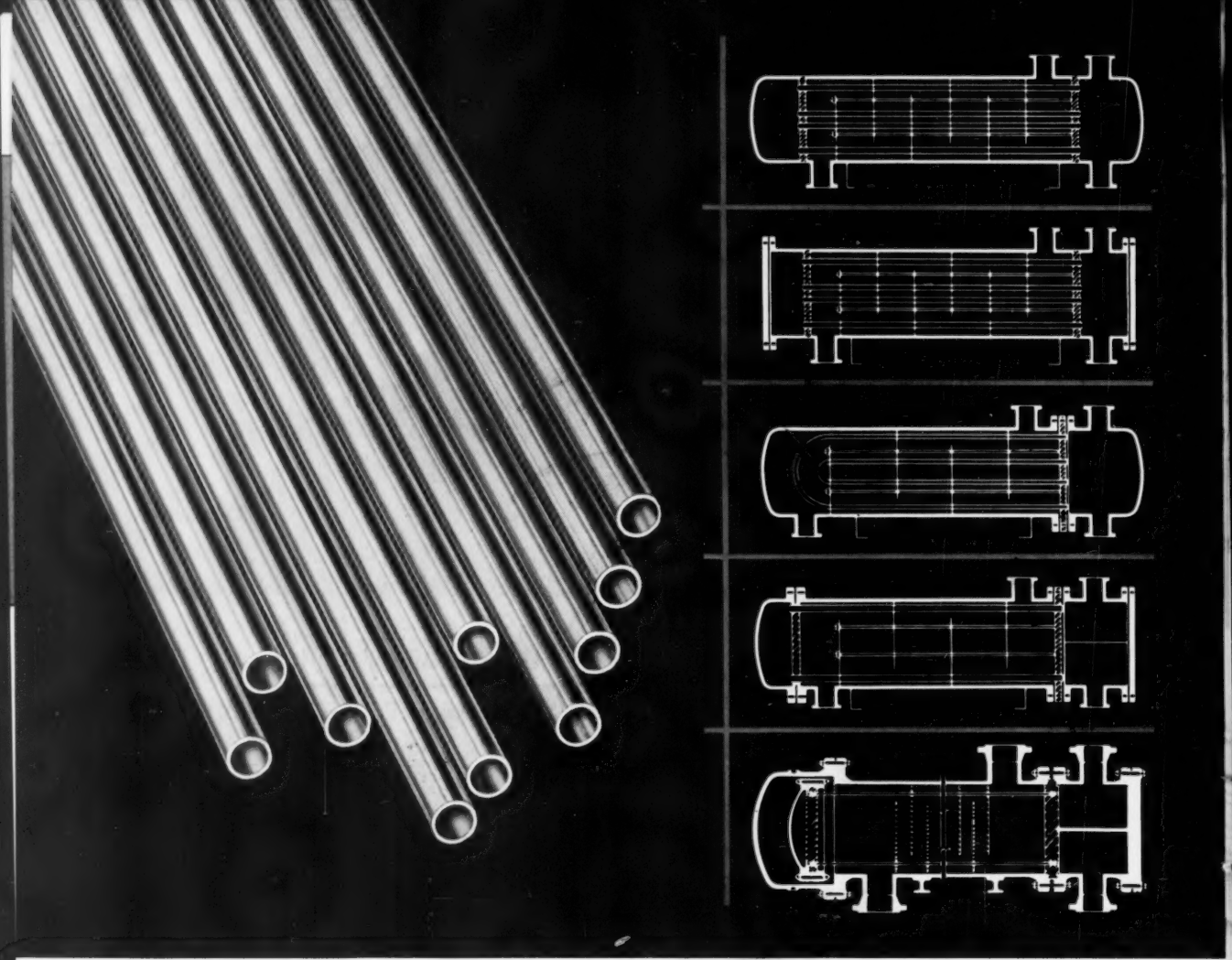

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STEVE ELONKA
Associate Editor in Charge

Mental health... plant maintenance problem

By R C BELLAS, *Assistant Editor*

It's a *big* problem

Insurance company survey shows that up to 25% of *all employees* in any plant suffer from some form of mental disturbance.

It shows up in...

- Top personnel breakdown, operating force injury
- Costly accidents which destroy property, hurt production, boost insurance rates. 90% of all plant accidents involve personality factors
- High turnover rate. Ups replacement, training costs. Emotional disability causes 60 to 80% of employees to transfer, quit or get fired
- High absentee rate. Illness stemming from mental causes adds up to big percentage of all absence of new or long-time employee

► MAINTENANCE, as we normally think of it, means keeping plant equipment in good shape. It means scheduled outages for inspection, testing and elimination of potential trouble spots. Or, if a piece of equipment breaks down in service, getting it back on the job in a hurry is the function of maintenance people. Thus, we generally distinguish between operation and maintenance departments in a plant.

But *maintenance*, in the true sense is wrapped up in the meaning of the verb "maintain" which Webster defines as "to carry on." And carrying on today's plant operations involves maintenance not only of the power services and related equipment, but of the *people* who operate the plant.

Big strides have been made in this direction. Employee safety and comfort gets top priority across the land. Trained engineers supervise plant safety

programs; doctors and nurses staff plant hospitals and dispensaries for preventive medicine and first-aid duties; air conditioning, noise-abatement studies, interior lighting and color schemes and a host of other items point up the trend to provide for the employees' well-being. All of which naturally results in increased employee efficiency, and with it, productivity.

Despite all-out efforts of plant safety programs (many stress both "in-plant" and "at-home" safety practices), annual losses of both plant and employee earnings from the "two big A's," *accidents* and *absenteeism*, still add up to some startling figures. Big loss, not measurable in dollars and cents, is in the suffering and deaths from plant accidents. In 1956, some 15,000 workers died, more than two million were disabled in industrial accidents.

These figures reflect a downward trend resulting from accident-prevention research during the past twenty years, but they're still too high and will be too high so long as one man dies or is disabled in a plant accident.

"But accidents *will* happen," you say. "Trying to operate a power plant month in and month out without someone getting even slightly hurt is like shooting at the moon."

It's agreed that there'll continue to be some skinned knuckles from wrenches slipping and things of that sort. But a number of plants have hung up some remarkable no-lost-time accident records which indicate that if they're shooting at the moon, they're hitting it. The records result in part from safety features built-in by equipment manufacturers and a plant's up-to-the-minute accent on safety practices. Biggest share of credit, however, belongs to the right mental attitude of the people who operate the plant. And in the final analysis, the employee's mental attitude is the factor that'll make or break any plant's no-accident record.

Authorities agree that about 80 to 90% of accidents result from personality problems. Further, it's fairly well established that about 80% of the accidents happen to about 30% of the people. The same statistics hold true for absenteeism—about three-fourths of absences in any given year occur to about a third of the employees. And this doesn't change with length of service. The absenteeism pattern stays about the same in the twentieth year as it was in the first year.

Case studies of accident-prone and sickness-prone employees invariably unearth the common denominator—some form of emotional upset. It ranges from a temporary period of anxiety, during which the accident or absence occurs, to mental illness severe enough to warrant immediate medical or psychiatric treatment.

Emotions, good and bad, are man's constant companions whether he's top brass or a plant laborer. Understanding the destructive ones can reveal and forestall many accident causes. Causes deep in the private life of the individual may bring about, in their logical sequence, accidents which are completely inexplicable on the surface. There's more connection between the size of the doctor bill for treating his sick child and the employee breaking his leg at the plant than would be thought possible by the average individual. An accident-prevention program designed to reach the *causes* and to compensate for them, must get the whole picture of the employee—not just the part that shows at the plant.

Several careful surveys have shown that the majority of people that fail on the job (transfer, get fired or quit) don't fail because they haven't got ability, but because *they can't get along with other people*. At first, management didn't feel anything but relief when he got the "trouble-maker" out of his hair. Then it became relief strongly flavored with regret because "the guy has a lot on the ball, it's a shame he's got such a lousy personality." Now, there's more and more of a tendency to realize that "something's bothering the guy" and to make an effort to help him.

An emotionally disturbed employee affects plant operations in different ways, depending on his authority level. The man in the walnut-panelled office has his emotions as well as the man in the boiler room or machine shop. But emotional upset of the man in the front office can make itself felt down through the chain of command, create anxiety, uncertainty, etc in others. The executive works under business as well as personal stresses; for this reason industry, with an eye on the terrible toll taken of key men by heart attack or nervous breakdown, is moving to give him protective medical and psychiatric buffers.

The lower-level employee in the plant may be emotionally upset for entirely different reasons, but they'll just as effectively put him out of commission. When this happens, plant operation has to suffer through a disabled or absent employee, damaged equipment, lost production, higher insurance rates and so on.

Nonexecutive class employees make up the bulk of workers in any plant so it's reasonable to assume that the greater part of industry's annual losses from accidents and absenteeism occur in this group. Situation's gravity is highlighted by an insurance company's recent survey showing that *25% of all employees* in any industrial plant suffer from some form of mental disturbance.

What's the answer? Top medical and human relations people agree there's no blanket solution, mainly because no two individuals are alike. But they also agree that two important steps, if taken, will put any plant on the road to finding its own answer. First, recognize the problem for what it is and take official steps to do something about it. Second, the individual plant worker must realize that worry, regardless of the source, can cause an accident that may cripple or kill him. With his mind on something else, he's a menace to himself and to the plant.

Plant conditions may or may not be cause for an employee's worry, though the plant feels the effect in either case. However, it's no secret that poor supervisor-employee relations can set up a snarl that's tough to unwind—a situation that has been given much attention and isn't half the problem it used to be.

Another situation, not so well known, is typical of some of the areas that'll have to be explored in the battle against emotion-caused accidents. No survey has been made of this one. It's doubtful, because of the nature of the problem, if a factual survey could be made. Fortunately, it's a problem that's easily solved as compared to some of the others. In substance, it's this:

The increasing use of complex, automatically controlled equipment is having an emotionally upsetting effect on a considerable number of plant operators. It isn't the often-heard complaint that "automation will put a lot of men out of work." It is, bluntly, the fact that the equipment is there, the men have to operate it and they don't understand all they know about it. In other words, they're a little afraid of it. Afraid that if something goes haywire, they may not be able to stay on top of it. Worst of all, they hide this feeling and live in anxiety—worried because the "chief" may find out and think they're incompetent. Odd part is, the majority of these men are competent. They just haven't been given the chance to learn all they should know about the equipment. The fact that they worry about it is proof that they're conscientious employees.

This anxiety colors their actions. Different men react in different ways but

it adds up to the same result. Their efficiency drops off, and they're hard to get along with. It's rough on a man's family because it's easier for him to brood, be surly or blow his stack at home than when his boss is around.

At the plant, he may have a tendency to be quiet and morose, argumentative or loud and overbearing. Maybe his supervisor will have a man-to-man talk with him, tell him he's not doing himself or the plant any good by being tough to get along with. In doing this, the supervisor is genuinely trying to correct a bad situation and is as sympathetic and understanding as he knows how to be. But he's not going to do much good, if any. It isn't the supervisor's fault that he doesn't get any results. After all, he's not a psychiatrist. How is he to know that, as an expert consultant puts it, "emotions can't be changed or rubbed out by an appeal to reason; their driving power comes from pressures deep within the mind, and mere logic can't touch them."

What to do about it? The plant that makes sure its men have every opportunity to learn all they can about their sphere of operations is the plant that's well on the road to getting top efficiency from its people and equipment. The "chief" who keeps system and equipment drawings and operating instructions manuals locked in his desk because he doesn't want the men to think they "know more than he does" sets up a psychological block that'll show up, sooner or later, in accident or absentee forms in plant records.

Equipment manufacturers, too, could help lick the problem by overhauling their operation and maintenance instructions manuals. Many of these are too complicated, both in illustrations and text, for men who haven't had a formal engineering education.

Educational programs designed to give men the confidence that comes with knowing they're masters of their jobs can pay big dividends. Human relations training for supervisory-level employees is a smart move. It'll show up in fewer accidents, lower maintenance costs, higher production and better all-around public relations.

Even though not responsible for an employee's emotional upset, industry is veering away from the "it's not our problem" and toward the "brother's keeper" philosophy. A movement toward in-plant personal counseling and support of community mental health clinics is getting under way. Unfortunately, the people who need this sort of help are the ones who are dragging anchor.

Too many people instinctively feel that the suggestion that they may need psychiatric help is an insult. That it means other people think they're "crazy." Nothing could be further from the truth. Today, it's as normal for an emotionally-upset employee to discuss his trouble with a trained personal advisor as it is to see a dentist about a raging toothache.

Big roadblock to employees talking over their personal problems with anyone in the "company" is fear. Fear that their confidences will become part of their employment record and hurt their chances for a raise or promotion. While the fear is groundless (some personnel people feel that an employee proves his worth through his effort to get rid of a personal problem that's affecting his work) it's a tough one to eliminate. Consequently, mental health clinics or other counseling services completely separate from "company" connection get better results. Here, the employee feels that he gets the privacy he wants.

The best personal advisory service in the world, however, can't do a thing unless the person needing help admits that something is bothering him. Maybe he doesn't know the basic cause—it may surprise him when it finally comes to the surface—but he'll be a healthier, happier man when he knows exactly what to do about it.

In a nutshell, the plant employee who's got something on his mind that he can't handle by himself owes it to his family, his plant and his community to talk with someone trained to analyze such problems.

Making sure that trained personal advisors will be available, some key industrial people have pledged generously to support a Mental Health in Industry program for a three- to five-year period. Recognizing that the number one problem in American industry today is not production but *people*, the program is geared to help us if we need it —and if we'll *use* it.

ED. NOTE: *Based on data generously furnished by The National Assn for Mental Health, Inc, The Manhattan Society for Mental Health, Inc, Union County (N. J.) Assn for Mental Health, Inc, and the Metropolitan Life Insurance Co.*

"An ounce of prevention..."

Do you have complex, automatically controlled equipment in your plant? Have the men responsible for keeping it in service been trained to handle it? Or do just the supervisory people get the *how* and *why*—and keep most of this under their hats?

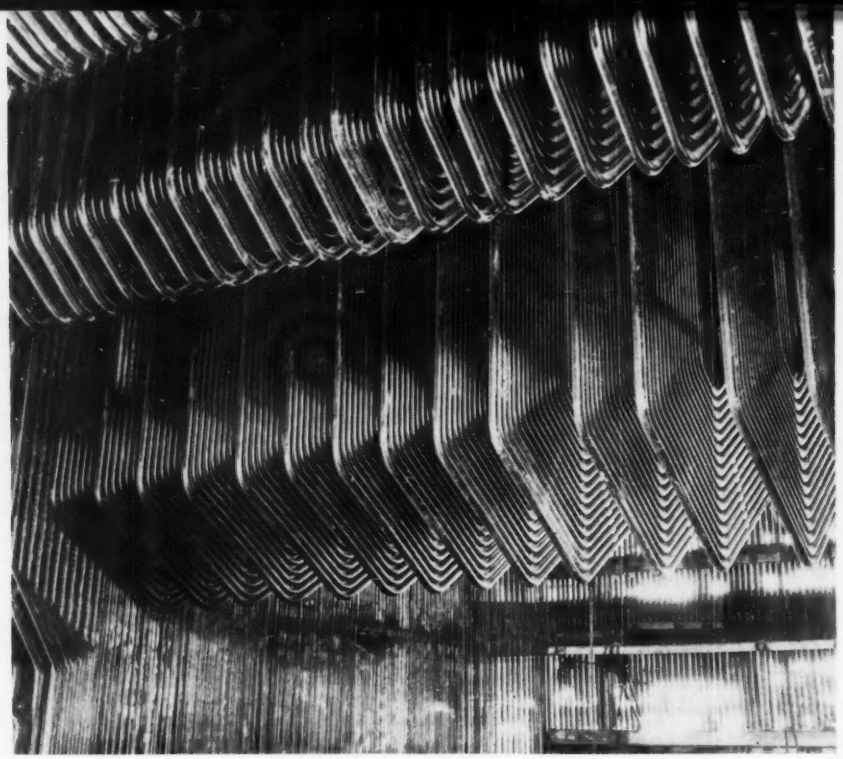
If so, maybe this is one of the reasons your absentee or no-accident record isn't too good. Investigation shows that *worried* employees are illness, accident-prone. And conscientious employees *do* worry about being responsible for equipment they don't completely understand.

A plant *safety* program isn't complete unless:

- An educational program insures that men understand the equipment they're operating and maintaining
- Operating instruction manuals and drawings are available for study, not locked in the "chief's" desk
- Supervisors get some basic human-relations training. Regardless of whether the employee's emotional upset is caused by plant or home disturbances, chances are high it'll result in an accident at the plant or the man being absent. Supervisors, trained to spot the man early, see that he's routed toward help. They can do much to cut today's soaring absenteeism, accident rate

STEAM

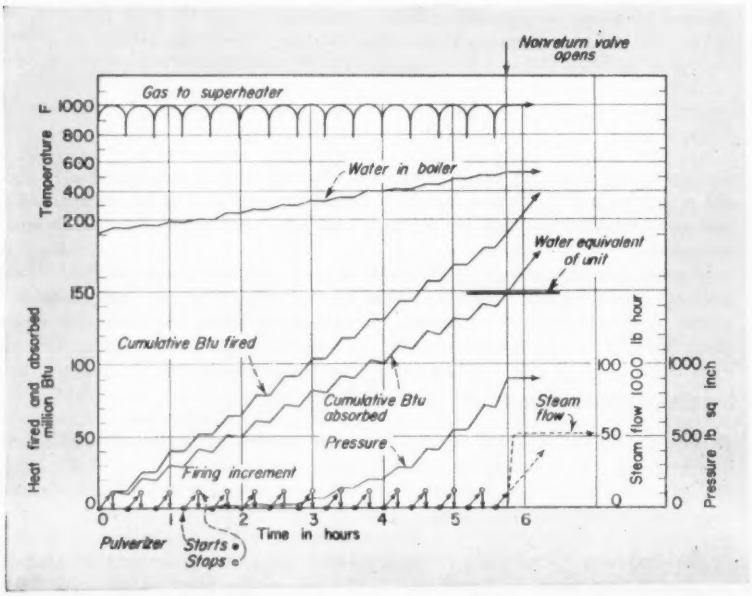
By R C BELLAS, *Assistant Editor*



SUPERHEATER DESIGN is big factor in high-temperature steam plant performance

Boiler start-up is the critical period. Slow firing plus even heat distribution are . . .

Keys to superheater protection

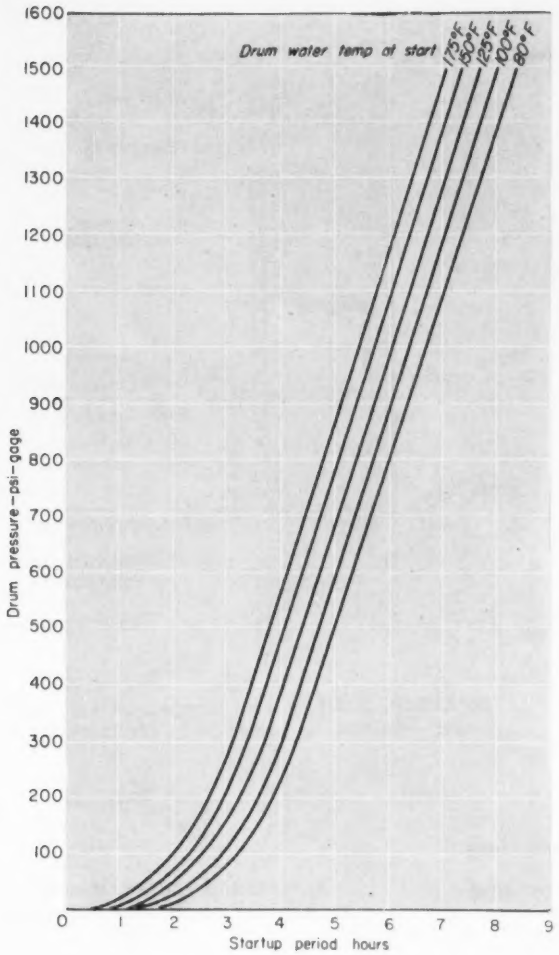


1 On-and-off firing is often necessary for superheater protection at start-up of cold steam generator. Rapid gas temperature rise occurs during "on" period

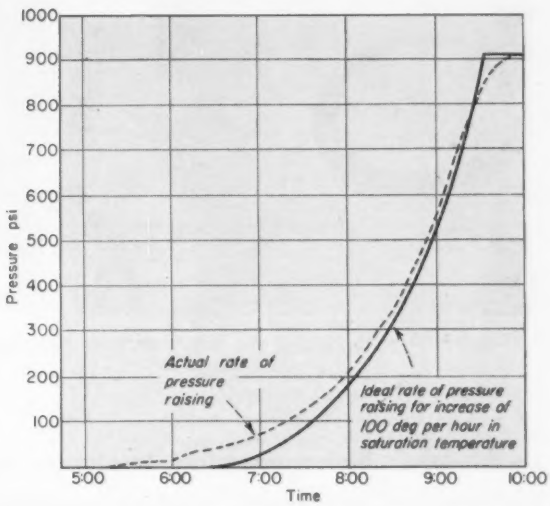
► SUPERHEATERS may differ in type, but they have one important characteristic in common. They can be badly hurt if an operator is careless, or doesn't realize what's involved when firing up a cold steam generator. During start-up, little or no steam flows through the superheater. If firing rate is too fast, gas temperatures quickly raise superheater metal temperature to the danger point.

A slow controlled firing rate and uniform heating at the superheater elements is good start-up procedure in a nutshell. It's especially important to follow this procedure with nondrainable units. These generally are partly full of condensate, and steam will flow only through elements that are open throughout their full length. The condensate won't "blow through," but must be completely evaporated by careful firing. If not, the dry tubing section will overheat, possibly rupture.

Fast firing of any cold boiler, other than some small units whose design allows quick start-up, can set up damag-



2 Based on initial drum-water temp, chart gives approximate time needed to bring the cold boiler to line pressure



3 Pressure rise from cold start must be controlled by slow or intermittent firing, use of superheater by-pass damper

ing stress concentrations. Add a superheater to the boiler and your chances of getting away with fast start-up are considerably less.

Superheater design provides for a definite pressure drop across the unit from inlet to outlet during normal operation. This "built-in" pressure loss is to make sure each tube or element gets its fair share of steam flow. Any change in the number of tubes or elements would upset this distribution. It would have an effect on pressure loss and, with this, a change in superheater metal temperature. If the pressure loss isn't as much as it should be, then steam distribution isn't as positive among the elements as it should be. It follows then, that if some elements are choked with condensate at start-up and steam won't flow through them, net effect is a reduction in the number of elements available to handle steam flow. But *all* elements are exposed to the high-temperature gases. Result: Some elements, even though cooled by steam flowing through them, operate at higher than designed temperature level while elements with water in them severely overheat along dry sections because of no steam flow through them.

Heat absorbed by a superheater *must* be carried away at the same rate that it's received. Even during banked fire periods, steam flow through a superheater exposed to high temperature is every bit as important as having water in a boiler when it's fired.

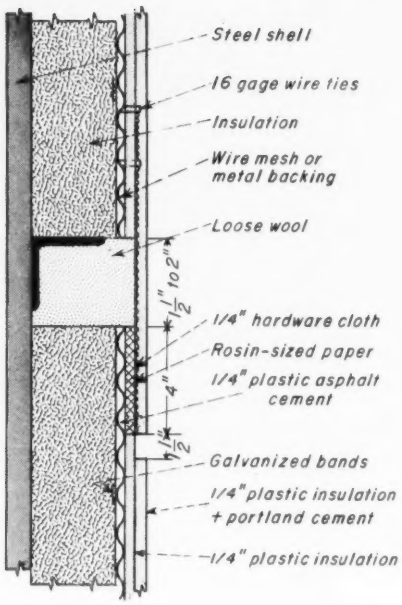
Superheater drains should be wide open during start-up. Some operators, wanting to save steam, or to bring boiler pressure up faster, may pinch in on the outlet drains. While this may not be risky with some installations, best bet is to leave outlet drains wide open until the boiler is on the line. If the boiler has steam - temperature - control dampers that permit some gas volume to by-pass the superheater, the dampers should be wide open during start-up.

Nondrainable superheaters, or those that can't be completely drained, can be protected by proper use of the dampers. Depending upon whether path of by-passed gases is over upper or lower portions of the superheater, the damper should be closed or partly open to get lowest-temperature gas flow over water-pocketed tubing sections.

Light off with the smallest practical fire that'll generate steam. With burners, keep their use uniformly distributed where possible. With a stoker, use a small fire across the full width of the grate. Sometimes it may be necessary to use controlled intermittent firing to hold superheater temperature even and below the danger point. Fig. 1 graphically shows what happens in a moderate-sized steam generator when brought up to line pressure by intermittent firing. Note that temperature equalizes during the "off" period and that temperature of gas to the superheater increases rapidly during the short firing period. It's easy to see why burners are cut off after every five minutes.

Watch steam temperature as shown by the thermometer at the superheater side of the outlet drain. Don't depend on the panel- *(Continued on page 232)*

STEAM MAINS being covered with high-temperature insulation



EXPANSION JOINT on a h-t breeching or duct. Space between sections is packed with fibrous insulation

Double-layer high-temperature insulation means less maintenance, comfortable working temperatures and no fire hazard. Here's . . .

By **MARSHALL F ALLEN**, *Manager*
The Magnesia Insulation Manufacturers Assn

What you should know about

► STEAM PRESSURES and temperatures are rising constantly in order to produce more economical steam-generation equipment. Because of this, more plant engineers are coming to grips with high-temperature insulation problems.

Temperature limits. Insulation development has more than kept pace with increased temperature. Limits recommended by MIMA for normal service are:

Material	*Temperature limit*
85% magnesia	up to 600 F
Calcium silicate	up to 1200 F
Expanded silica	up to 1600 F
Diatomaceous silica	1500 to 1900 F

But selecting insulation by heat tolerance alone oversimplifies the problem. No one insulation is best for all applications. Conductivity or *k factor*, structural strength, resistance to mechanical damage, water resistance, compressibility, ease of application and workability must all be considered for each job.

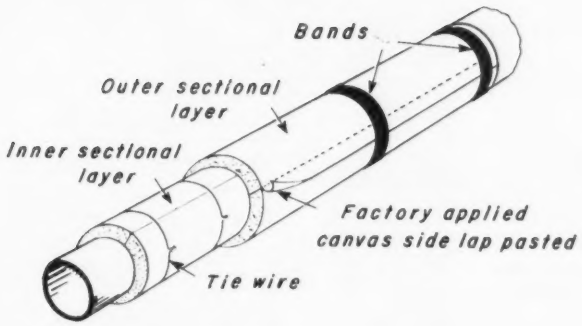
Thermal expansion. One byproduct of high-operating temperature is expansion of equipment and piping. This problem will be with us until someone develops a metal that does not expand at high temperatures.

Insulation problem is generally solved by using double-layer construction with staggered joints, illustration, p 115. Through-joint openings from metal to air are eliminated, since joint separations occur in one layer only.

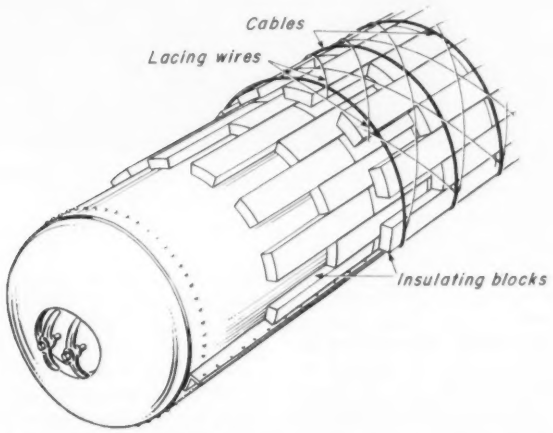
Typical combination is diatomaceous silica and 85% magnesia insulation. Diatomaceous silica is applied to the hot metal in a thickness calculated to reduce outer-surface temperature below 600 F. Then 85% magnesia is applied in thicknesses needed to reduce heat loss to economical level. High heat resistance of diatomaceous silica and low conductivity of 85% magnesia combine to give an excellent insulation.

One vs two layers. Some engineers feel that two-layer insulation is unnecessary with materials like calcium silicate and expanded silica. Both insulations combine high heat resistance and low conductivity in a single layer. In addition, installation cost is lower.

But single-layer construction does not allow for thermal expansion of equipment and piping. In every 100 ft of steel piping at 820 F there is about 8 in. of expanded bare metal between insulation joints. Multiply that by the many hundreds of feet of pipe in the



DOUBLE-LAYER sectional pipe insulation showing staggered joint construction to allow for thermal expansion of the pipe



CYLINDRICAL SURFACE of steam drum using double-layer insulation. Blocks are held by wire laced to anchored cable

h-t insulation

average plant and you begin to realize that a lot of heat is wasted.

Insulation jackets or other finishes are scorched and damaged at open joints calling for constant maintenance. Exposed hot pipe is a considerable fire hazard, particularly in plants handling flammable materials. In many cases, working temperature is raised to an uncomfortable level.

Expansion joints, like the one on page 114, can solve some of these thermal expansion problems. But the great number of joints needed for most piping are expensive to install and maintain. Best solution is double-layer construction wherever there is appreciable thermal expansion of piping and equipment.

Expansion joints are more often found at elevated temperatures on long runs of ducts or breeching and large pressure vessels. General practice is to leave an inch or two between every second or third insulation block or section for thermal expansion. This space is packed with fibrous insulation and covered by a sliding collar or shield.

Standard thickness is a holdover from the past that continues to plague engineers. It implies that there is a standard thickness for a given size of pipe. Use of this term was common before the days of the superheater when steam was only saturated. Avoid use of specifications that call for standard or double - standard thicknesses. Aside from the fact that they are probably inadequate, they no longer exist.

Simplified thickness. MIMA has adopted new thickness schedules that list four insulation types by nominal half inches for ease of reference. For example, 2½-in. nominal thickness insulation on a 1-in. pipe is 2 21/32-in. thick. Actual thickness is used only for critical engineering calculations.

One advantage is that outside diameter of pipe insulation is then about the same as outside diameter of iron pipe sizes. It can be applied directly to pipe or as a second layer on smaller size insulation.

Another advantage is simplified inventory records for the plant engineer who has to keep a stock of insulation for maintenance. Odd fractional-inch sizes do not have to be stocked.

Outdoor plants. Number of outdoor applications is increasing. Plastic asphaltic compounds with 1-in. wire mesh reinforcement and binder give good protection on smooth insulation surfaces. Flashing is needed to prevent seepage at conical tips of vessels and similar points. Good insulation will withstand repeated wetting and drying. But wet insulation will not effectively prevent heat loss.

Aluminum jackets give good protection and improve plant appearance. But corrosion inside the jacket presents a problem. One theory is that alkaline nature of most insulation has a catalytic effect on the aluminum. Another attributes corrosion to the use of scrap aluminum in producing sheet and/or improper alloy composition.

Extensive tests by both insulation and aluminum manufacturers prove that corrosion is generally independent of insulation type and aluminum quality. All you need is moisture. Since it is almost impossible to keep all moisture out of the jacket, the inner surface must be given a protective coating.

What's ahead? Insulation is available to handle most of today's industrial temperatures. But the trend to higher temperatures in nuclear and critical-pressure power plants spotlights the need for continued research. Since organic materials or binders cannot be used as basic ingredients, research is presently confined to known inorganic substances. Much has already been learned about basic theory of heat flow in insulation and basic materials are constantly examined for their effectiveness in formulating new insulations. Most of this research is based on the fact that the most effective material for barring heat passage is one with countless millions of microscopic air spaces. Efforts are directed at developing products with greater heat resistance, lower conductivity and greater durability.

Burning residual oil saves $44,000 a year

In spite of rising fuel prices, here's how one generating plant cut operating costs with a residual oil-burning diesel

By L LONG,
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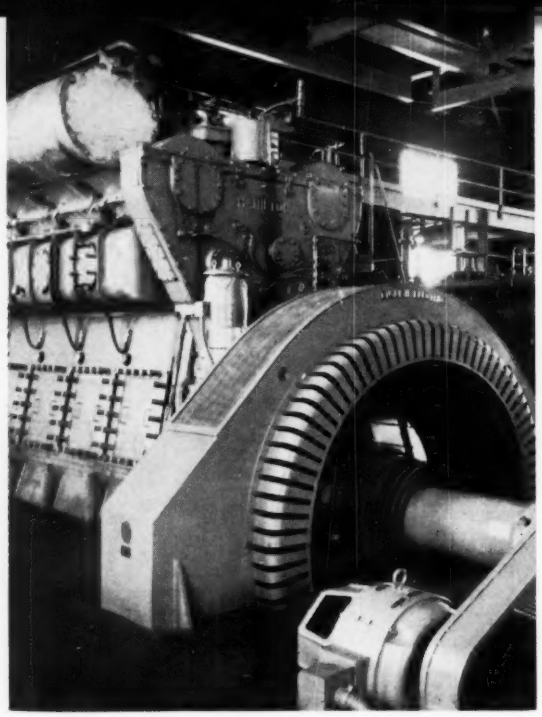


GENERATING PLANT burns residual oil in 2400-bhp diesel

► RESIDUAL OIL-BURNING diesel generator, above, saved $44,000 last year in operating fuel costs. At this rate, fuel savings alone are enough to pay for the installation in less than six years' normal operation.

Operating cost averages 7.2 mils net compared with 12.4 mils net per kwhr for our other engines using distillate fuel. Fuel cost is 18.6c per gal for distillate quality compared to 11.6c per gal for bunker-C residual.

Further savings are expected when electrical heating equipment on the heavy fuel line is replaced by a hot-water heat exchanger installed in the engine exhaust. Cost per kwhr should decrease from 7.2 to 6.5 mils. Longer term operation is necessary before we can make any valid comparison of relative maintenance charges.

Rotary exhaust valve system is the secret of the Hamilton engine's ability to burn heaviest fuel with clear exhaust. It controls exhaust-gas scavenging so that 40% more clear air is retained in the cylinders. This extra air charge, plus high-turbulence combustion-chamber design give the right combination for burning residual fuel.

Motor-driven blower with fully automatic inlet guide vane control provides scavenging air supply at a pressure proportional to engine load. The motor —250 hp, 3550 rpm, 2300/4160 v—is directly connected to the generator terminals. As a special safety feature, blower overloads are provided to trip the main generator oil circuit breaker and engine overspeed mechanism.

Fuel system can use both residual and light oil. Light fuel is used for starting and for about 20 minutes before shutdown to flush fuel lines and injectors. All other normal operation is with heavy residual oil.

Light-fuel system includes storage and day tanks, plus level controls and pumps. System is primed with a hand-operated pump.

Heavy oil is stored in two 20,000-gal tanks that are heated with steam coils and automatically controlled suction heaters. Storage tanks and unloading pump house are served by 4-in. steam lines running underground with condensate return and fuel piping. These are group insulated to maintain full oil heat.

Self-cleaning 330-gph centrifuge conditions heavy oil before storage in 3000-gal clean oil tank in the power-plant basement. From here it is pumped into the 275-gal day tank.

Fuel piping is arranged to automatically feed light oil to the engine if there is any trouble in the residual line. Both fuel lines feed into a tee with check valves in each branch.

Light-fuel pump is engine driven. Regulating valve keeps outlet pressure about 10 psi lower than the similar heavy-oil system. With switch to heavy fuel, light oil is recirculated back to the day tank at regulating valve set pressure.

If pressure in heavy-fuel system drops below setting for light-fuel system, light fuel is admitted and heavy-fuel check valve closes. This double-check valve system prevents mixing two fuels.

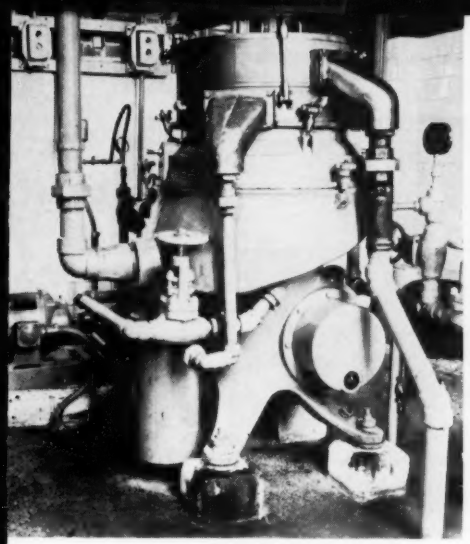
Visible and audible alarms warn the operator when heavy-fuel pressure drops below normal and the engine is running on light oil.

Far end of the engine's fuel-oil header also has a pressure-regulating relief valve set to by-pass fuel oil at all times. It assures correct pressure, constant flow and even temperature. Spill from the relief valve goes to a 3-way valve for switching to either light- or heavy-fuel day tank. Heavy-fuel spill cannot be returned to the light-fuel day tank. But light-oil spill can be returned to the heavy tank without clogging strainers and filters.

Heating. Temperatures are controlled to maintain proper viscosity for each step in oil handling. For example, viscosity for pumping must not exceed 5000 ssu. Centrifuging requires 100 to 200 ssu and 70 ssu is normally needed at the engine fuel header.

Electric heaters are used for the engine-fuel header. Steam heats residual fuel during unloading and transferring, centrifuging and storage in the day tank. It is supplied by a combination waste heat boiler and exhaust silencer. Pressure is automatically controlled at 12 to 15 psi by pressure actuated valves in the dump line and feedwater inlet. At full engine load, boiler output is 2500 lb per hr. It drops to 1600 at three-quarter load.

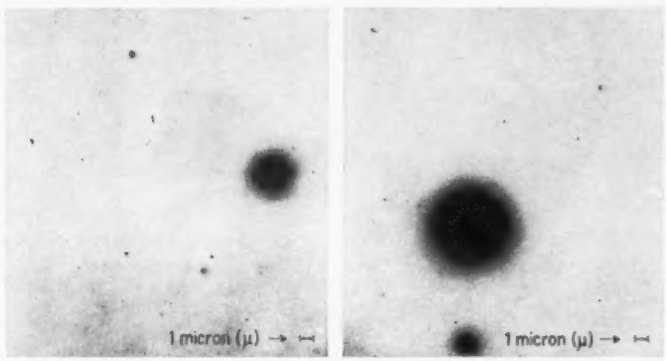
Boiler feedwater is treated with a



Residual-oil centrifuge

Sludge and other foreign matter in the residual oil, removed by centrifuging, averages between 1.0 and 1.2% by volume. Of this amount, the water and sediment averages between 20 and 30%

Microscopic look at bunker-C fuel



Dirty oil **Clean oil**

Particle distribution and size in microns

Dirty oil	Clean oil
80% particles—1.0 to 2.2	97% particles—0 to 2.0
15% particles—2.2 to 10	2% particles—2.2 to 4.4
5% particles—11 to 25	1% particles—4.5 to 40 *
1% particles—26 to 60	

Material remaining in the clean oil sample shows a definite tendency to agglomerate. *Those particles larger than 10 microns are actually clumps of much smaller particles averaging about four to six micons

blend of organic material plus sodium sulfite and caustic soda. Standby boiler was not installed because heat for residual fuel is needed only when the engine is running.

Centrifuging. Table, right, gives analysis of oil before and after treatment. Photomicrographs compare samples of clean and dirty oil at a magnification of 6000. Trouble-free operation of the heavy-fuel system depends on reliable centrifuge operation and performance.

Cooling. Closed-engine cooling-water system consists of lube-oil cooler, engine jacket-water system and a conventional core type radiator installed outside on a concrete foundation. At full load the radiator dissipates heat from jacket water and lube oil at 84-F outdoor wet-bulb temperature. Radiator fan is driven by a dual-speed motor for economical temperature control.

Radiator fan motor develops 30 hp at high speed and 7.5 hp at low speed. When outdoor temperature rises to about 55 F, high-speed is used. Jacket-water temperature is controlled by a 3-way thermostatic control valve. Lube-oil heat exchanger uses a similar setup.

Antifreeze, containing rust inhibited alcohol, is used in the jacket-cooling water system for below freezing temperatures. Chromate treatment protects against rust during warm weather.

Hot water for building heat is obtained from the jacket-water system. Pumps circulate this water through unit heaters when the engine is operating.

Complete heavy-fuel analysis

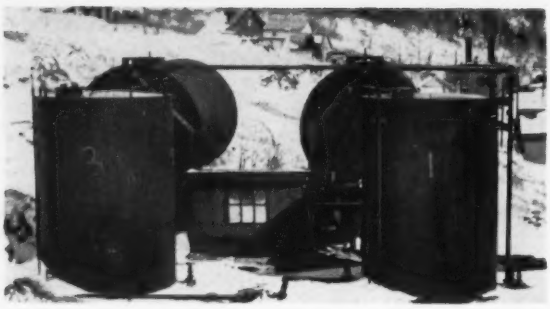
	Dirty oil	Clean oil
Specific gravity 60 F	0.997	0.996
API gravity 60 F	10.4	10.6
Flash point, open cup F	290	280
Fire point, open cup F	325	320
Viscosity, ssu 100 F seconds	3170	3175
Viscosity, ssu 180 F seconds	274	275
Viscosity, ssu 210 F seconds	155	155
Viscosity, furol 122 F seconds	127	128
Sediment, hot filtration, % by weight	0.27	0.07
BS & W ASTM-52T, % by volume	1.40	0.25
Carbon residue, % by weight	11.17	10.77
Ash at 550 C, % by weight	0.100	0.070
Water by distillation, % by weight	0.20	0.04
Sodium, uranyl acetate, % by weight	0.0086	0.0032
Sulfur, % by weight	0.620	0.349
Vanadium, % by weight	0.019	0.010
Pour point	+30 F	+30 F
Btu per lb	18.300	18.330

Lube system. Mechanical forced-feed lubricators supply oil to the engine cylinders. A pressure system is used for piston cooling, bearing lubrication, exhaust rotary valve and gear case.

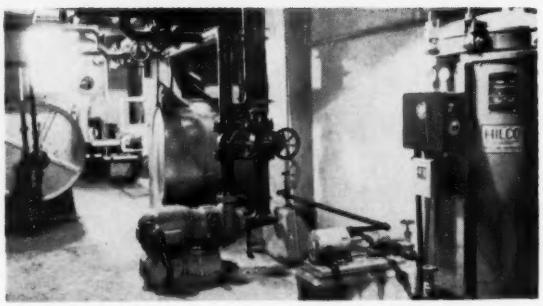
Cylinder lubrication oil—stored in a 200-gal tank in the basement—is pumped to lubricator reservoirs. Operation is controlled by a pushbutton mounted near the lubricators.

Pressure-lubricating system consists of a sump tank, engine-driven pump, motor-driven standby lube-oil pump, lube-oil coolers, strainers, filters and check valves. Oil is pumped continuously from the sump tank to the filter at 400 gph. Lubricating oil is a high detergent type. Filters use cellulose disk cartridges.

Electrical system. Generator is direct connected to the diesel and is rated at 2345 kva gross, 2125 kva net, 60 cycle, 2300/4160 volt. Net rating is 1700 kw at 80% power factor. Thirty kw exciter, rated 125 volts at 1450 rpm, is belt driven from the main shaft. During



OIL-STORAGE TANKS are located outside. Small building in the center houses controls for oil lines and steam heaters



MAIN BUILDING has antifreeze and light-oil storage, jacket-water circulating pump, lube-oil filter pump and filter

start-up, the exciter is rectifier-energized by special controls.

Bus voltage for all generating units is 2300. Each generator also has leads brought out for 4160 volt connection. Switchboard panels carry the voltage regulator, oil circuit breaker, relays—differential overload and reverse power, direct current ground fault detector, watt-hour meter and all other normal indicating instruments for current voltage and power factor.

Equipment location. Near the engine controls is a metalclad gageboard containing pressure indicators for light and heavy fuel, lube oil, jacket water, starting and scavenging air. Top section contains the alarm system for lube-oil low pressure and high temperature, jacket-water low pressure and high temperature, heavy-fuel low pressure and blower motor overload. Engine shutdown devices operate through relays on low-lube oil pressure, high jacket-water temperature and generator differential fault.

Gageboard also contains scavenging air regulating relay controls, blower motor meter and all pushbutton stations with indicating lights for auxiliaries.

Fuel centrifuge unit and blower are in separate areas adjoining the engine room. Directly above are two rooms containing the exhaust silencer and waste heat boiler combination, plus the self cleaning air filter. To reduce vibration, silencer and blower are completely independent of the building. They are supported on four reinforced concrete columns. Engine air is taken from outside during normal operation. Lever-controlled diverter in the air-intake room uses air from the exhaust silencer room for cold-weather starting.

Most of the other auxiliaries are located in the basement. This includes the lube-oil cooler, sump tank and clarifier, jacket-water pump and steam condensate tank. It also includes the heavy- and light-fuel day tanks, each holding 175 gal, boiler-feed pump, 300-gal heavy-fuel tank with steam and electric heaters and all piping connecting these auxiliaries to associated equipment.

Operating records for the period from January 1 to December 31, 1956

Total running time	5998 hr
Power generated (gross)	8,815,000 kwhr
Station use	281,000 kwhr
Power generated (net)	8,534,000 kwhr
Average load	1470 kw
Light fuel oil	37,766 gal
Heavy fuel oil (gross)	471,210 gal
Heavy fuel rejected	4930 gal
Btu per kwhr (gross)	10,370
*Btu per kwhr (net)	10,820
Btu per lb (heavy fuel)	18,310
Btu per gal (heavy fuel)	182,500
Btu per gal (light fuel)	167,000
Overall thermal efficiency (net)	31.6%

*Heavy fuel rejected and station use deducted

All gallons mentioned are Imperial gallons

Equipment serving new residual oil-burning diesel

Engine	Baldwin-Lima-Hamilton Corp
Generator	English Electric of Canada, Ltd
Exciter	Imperial Electric Co
Blower	Canadian Sirocco Co, Ltd
Blower motor	Canadian General Electric Co
Governor	Woodward Governor Co

Fuel system

Injection equipment	American Bosch Arma Corp
Centrifuge	De Laval Separator Co
Filters	Purolator Products, Inc
Pumps	De Laval Separator Co
Heaters	Davis Engineering Corp

Lube oil system

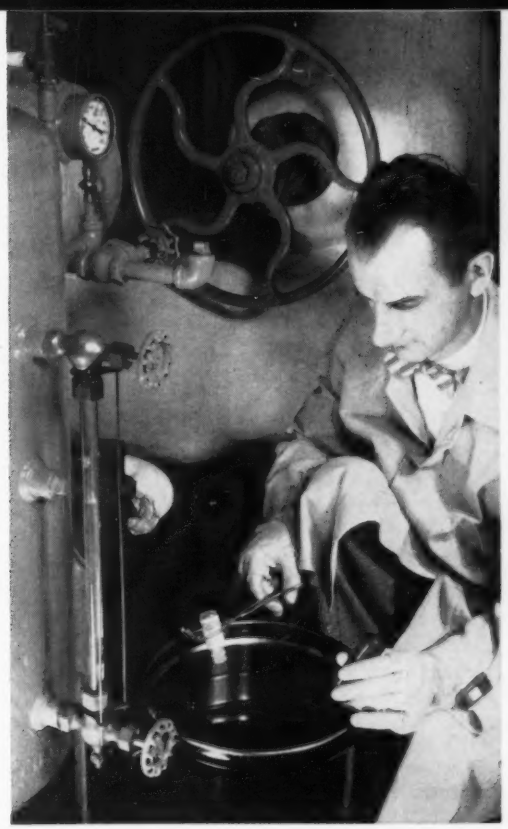
Mechanical lubricators	Madison-Kipp Corp
Coolers	Young Radiator Co
Filters	Hilliard Corp
Auxiliary pump	Blackmer Pump Co

Jacket-water pump	Ingersoll-Rand Co
Radiator	Young Radiator Co
Waste heat boiler & silencer	Maxim Silencer Co
Switchgear	Canadian General Electric Co, Ltd
Control board	Westinghouse Electric Co
Air filter	American Air Filter Co
Alarms	Viking Instruments, Inc

AIR CONDITIONING

We trace cooling-water leaks with radioactive isotopes

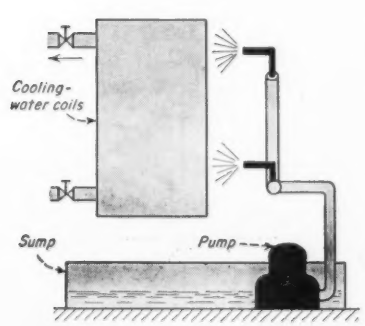
By **R L STUDLEY**, *Maintenance Superintendent*
B F Goodrich Company, Research Center



MIXING isotope, water and antifreeze for cooling coils

► AIR-CONDITIONING SYSTEM at the B F Goodrich Research Center operates with 100% fresh air. That means we must have our refrigeration system ready to operate when the outside temperature rises to 68 F, or when outside humidity is above 54-F dew point. These outside conditions occur not only in summer, but often in the spring and fall when temperatures below 32 F are common.

Water, with 20% solution by volume of permanent antifreeze, is medium in the cooling and dehumidifying coils to transfer heat. This also gives freeze protection all winter to –20 F. When temperatures drop to extreme, we don't have to circulate chilled water through coils as solution becomes a thick slush that's OK for coils. Whole system holds 2000 gallons of mixture, of which 400 gallons are permanent antifreeze.



ISOTOPES circulated in these cooling coils showed no antifreeze leaking out

We thought one or more of the cooling coils were leaking. Coils consist of copper tubes, six rows deep. This makes it tough to visually inspect the surface of all tubes for leakage. Tube surfaces are wetted from a bank of spray nozzles to increase heat transfer. This wetting also adds moisture for humidifying the conditioned air.

Leakage from inside the tube bank will be either evaporated or washed down and mixed with the spray water. So we thought of finding leaks with an isotope in the coils. Then isotope would contaminate spray water and be traceable with a Geiger counter in samples taken from sump.

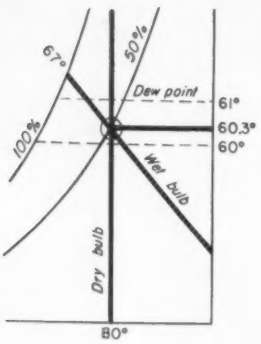
We mixed 10 cc of a solution of H_3PO_4 in HCl, containing the radioactive isotope P_{32} (from Oak Ridge) into 5 gallons of water and antifreeze mixture withdrawn from the system. Mixture was then charged back into the system through a surge tank and circulated for three days. After that, 3-cc samples were withdrawn from cooling coils at various points and counted. These samples counted 250 above background, which indicated that the isotope was uniformly dispersed. A 200-cc sample of the spray water was collected from each coil location, evaporated to dryness and counted.

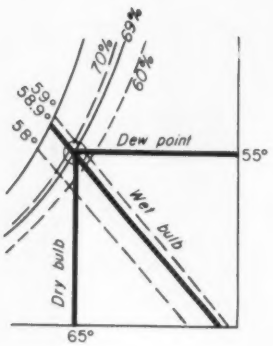
Although the count was nil for every sample (showing that there was no leakage) we estimated that a leak as small as 1 qt per day could be detected by this method.

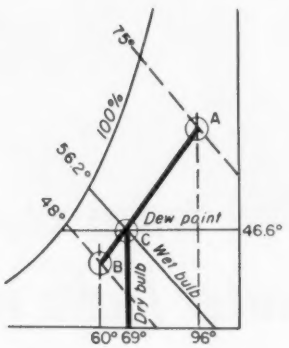
Safety. We used rubber gloves for protection because phosphorous irritates the skin, photo, above. No face shield was used because stirring was gentle to prevent splashing. Direct beta radiation from phosphorous 32 is high. But it is negligible when contained in a glass bottle or mixed with water in a pail.

We also used film badges on our sleeves and coat lapels to record the beta radiation from phosphorous 32. These are used by all employees here who handle radioactive material. To make similar tests, I suggest that POWER readers hire a firm employing qualified users as recognized by the Atomic Energy Commission at Oak Ridge, Tenn.

Here's how to figure humidity, wet-bulb temperature, air mixtures,







Humidity . . .

Let's assume you know dry-bulb temperature is 80 F and wet-bulb temperature is 67 F. You want to find dew-point temperature (temperature at which moisture will condense out of the air for a given specific humidity and pressure, as air-moisture temperature is reduced) and % humidity.

Find 67 F on the 100% humidity curve and follow the line parallel to constant wet-bulb lines. Then trace the line from 80 F on the dry-bulb scale. Intersection shows dew-point temperature is 60.3 F, humidity is 50%. This point represents condition of the air.

Wet bulb . . .

Now suppose you know dry-bulb temperature is 65 F and dew-point temperature is 55 F. You want to determine wet-bulb temperature and the % humidity. Approach is much the same as in our first example.

Follow the 65-F constant dry-bulb temperature line. Then, moving over to the vertical scale, locate 55 F. Intersection pinpoints air-moisture condition. Since chart doesn't have a fine enough grid, you'll have to estimate 58.9-F wet-bulb temp along the constant 100% relative humidity curve. The 69% humidity is also an estimate.

Air mixtures . . .

Let's say 25% (point *A*) of a mixture of two air streams is at 96-F dry bulb and 75-F wet bulb. The balance (point *B*) is at 60-F dry bulb and 48-F wet bulb. Then, $0.25 \times 96 = 24$; $0.75 \times 60 = 45$. Resultant dry bulb of the mixture is $24 + 45 = 69$ F.

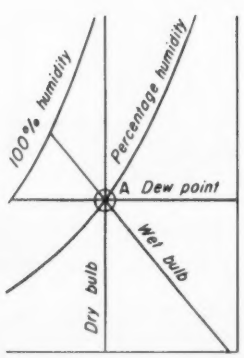
Now draw a line between *A* and *B*. Intersection of 69-F dry bulb with the line between *A* and *B* establishes point *C* for the mixture. Wet-bulb and dew-point lines, running through point *C*, are conditions of the mixture. Its wet-bulb temperature is 56.2. Dew-point temperature is 46.6 F.

Get to know air-moisture data

It sets the groundwork for well-planned air conditioning

Psychrometric chart shown here in skeleton form is nothing more than a graphic portrayal of various air-moisture mixtures.

Lines of constant dry-bulb temperature are almost vertical. Constant dew-point temperature lines are horizontal. Constant wet-bulb temperatures slope downward to right. Constant % humidity lines are curved. Before using chart you must know any two values. You can then pinpoint the air-moisture condition. —*Courtesy The Trane Co*

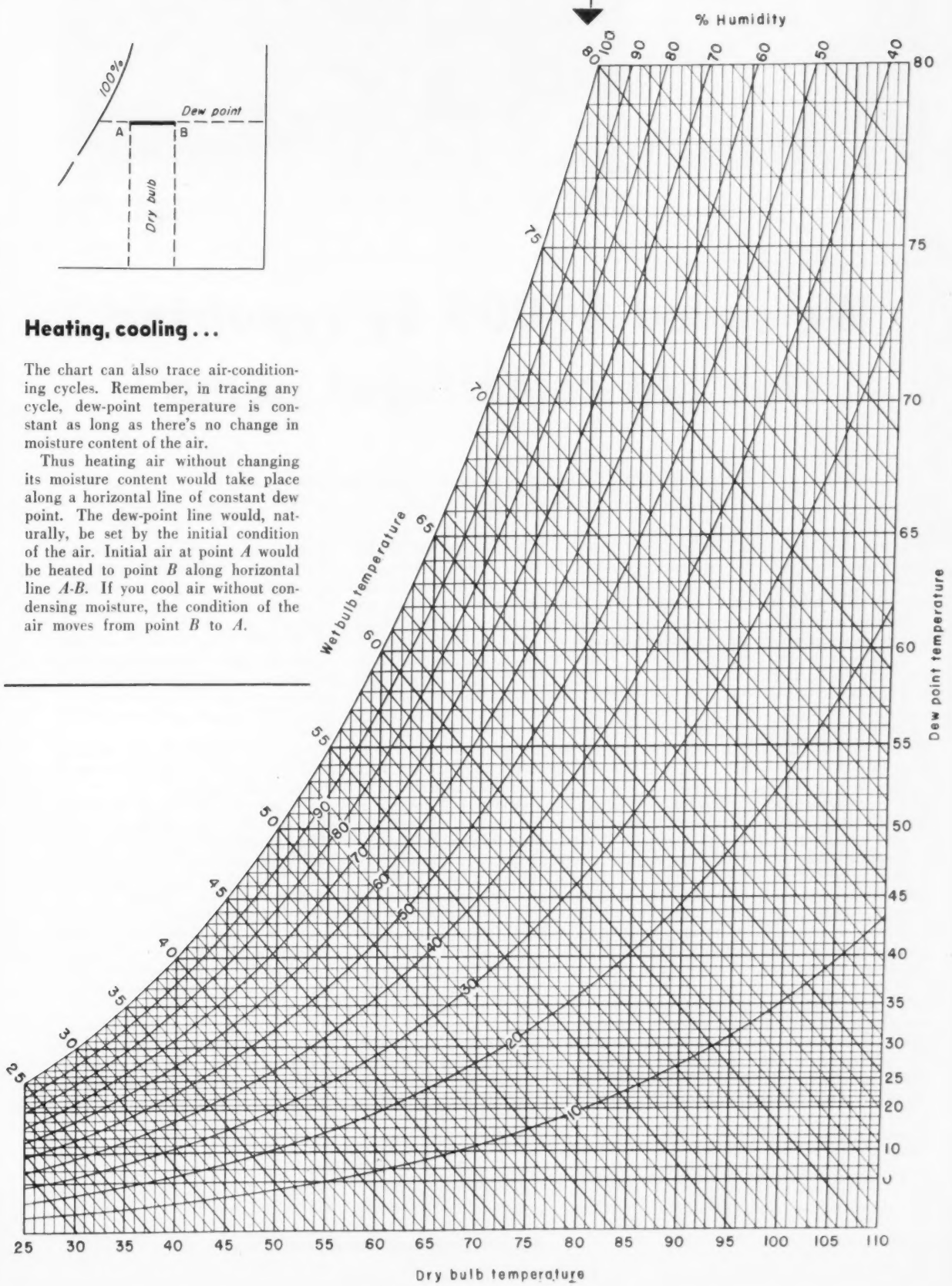


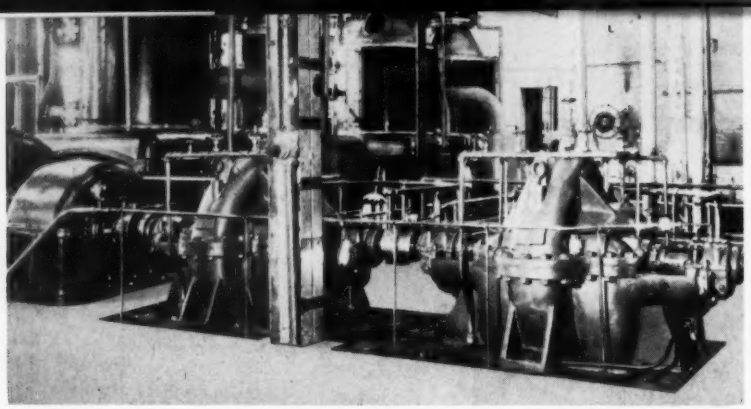
heating, cooling. And here's a psychrometric chart for your use

Heating, cooling . . .

The chart can also trace air-conditioning cycles. Remember, in tracing any cycle, dew-point temperature is constant as long as there's no change in moisture content of the air.

Thus heating air without changing its moisture content would take place along a horizontal line of constant dew point. The dew-point line would, naturally, be set by the initial condition of the air. Initial air at point *A* would be heated to point *B* along horizontal line *A-B*. If you cool air without condensing moisture, the condition of the air moves from point *B* to *A*.





GOOD AS NEW, this 12-million-gallon-per-day pump in large water works plant is all set for many more years of useful work. Unit has been working steadily since 1928

We saved $7000 by repairing this old centrifugal pump

By **JOHN MURPHY,** *Consulting Engineer, Metzger, King & Murphy, Narberth, Pa.*

► CENTRIFUGAL PUMPS in a water works usually need only routine maintenance, such as replacing packing, shaft sleeves, wearing rings or an occasional bearing. But we did a major overhaul that saved a large tandem unit from the scrap pile.

Pump is two-stages, 12-million-gallon per-day capacity. Installed in 1928, the two double-suction tandem units, are connected in series under the base, photo above. First stage discharges at 80 psi, second stage at 112 psi, to a filter plant two miles away.

Drive is by a 2500-hp steam turbine, through reduction gearing. Because efficiencies were good (around 86 and 87.5%) we felt we could save the pump.

Corrosion. Pumps handle highly corrosive raw water from the Monongahela River in the Pittsburgh area. As sketches show, tongue of discharge volutes was eroded back about six inches. Although some operators may not know it, this tongue erosion has little effect on pump efficiency. If we could stop erosion at this point, we could trim up ends of the tongue to about the original shape and contour. But erosion would continue until performance suffered. Eventually it would get so bad that repair would be out of the question.

Casings were also badly corroded. Photo, above, shows a great difference in surface character in suction chambers and discharge volute. Surface in suction chambers has a thin, hard deposit —likely to be carbonates and similar material because of its fairly smooth orange-peel surface. This coating was protective in nature as there wasn't any graphitic corrosion on the underlying cast iron.

Velocities in the discharge volutes are high. Therefore, no deposit had taken place but graphitic corrosion occurred in this area from scouring action of high-velocity water. Corrosion here is progressive. Graphitic corrosion won't usually penetrate rapidly if graphitized surface is undisturbed in this type of water. Then new metal isn't continually exposed to the corrosive action.

These machines were opened annually for routine inspection. Through the years, maintenance crews scraped the case ring-seats until loss of metal at seats became severe. Leakage under case rings caused further erosion. Cost of installing new cases for the four stages on both units was $10,000—another reason we decided to repair them.

Casing repair. We bored wearing ring seats in place with portable equipment. Then we installed bronze inserts, sketch. We made three setups per cutter head to machine the proper shape to receive labyrinth form of inserts. Then we designed bore of inserts to receive a standard replacement ring.

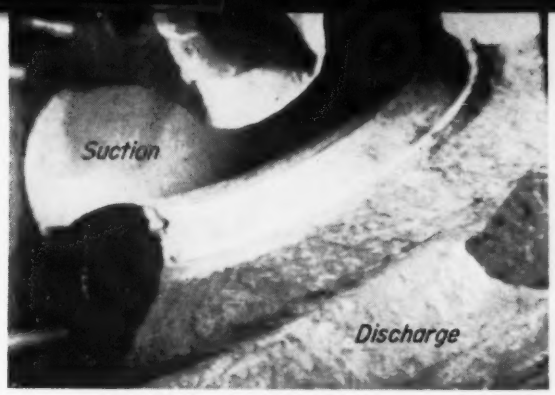
Restoring casing tongues to original shape, contour and clearance was next problem. We learned on a previous job that this problem isn't easy to solve by welding. In that case, one pump was welded by first drilling and tapping the area involved. Then we installed numerous small stainless steel studs and welded to these studs. The repair was successful, but so much metal was used to restore original shape and so much grinding needed to finish contour, that expense was too high. That's why we decided on a purely mechanical repair for this job.

Repair was done in steps, sketches, p 123. These repairs restored the units to original efficiency.

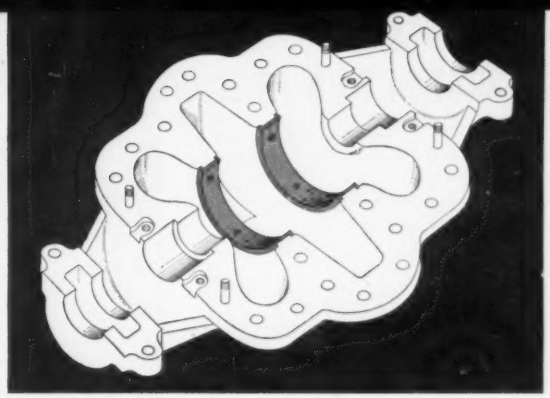
Cost per unit (two stages) of boring and installing bronze inserts was $1254. Rebuilding the tongues cost $115 per case. Total expense of complete repair of both units was about $3000, a net saving of $7000.

Before making repairs we drilled discharge section of cases to learn depth of corrosion. Drilling also told us that enough sound metal remained to withstand maximum case pressure with a safe allowance for future corrosion. While there was enough metal, we decided to experiment with protective coatings. Idea was to see if we could prevent this type of corrosion. Since units are opened annually, we hoped to find a coating that would remain sound during that period.

Coatings. We have experimented at other plants with rubber or neoprene coatings. They were applied to old cast-iron cases (properly cleaned and pre-

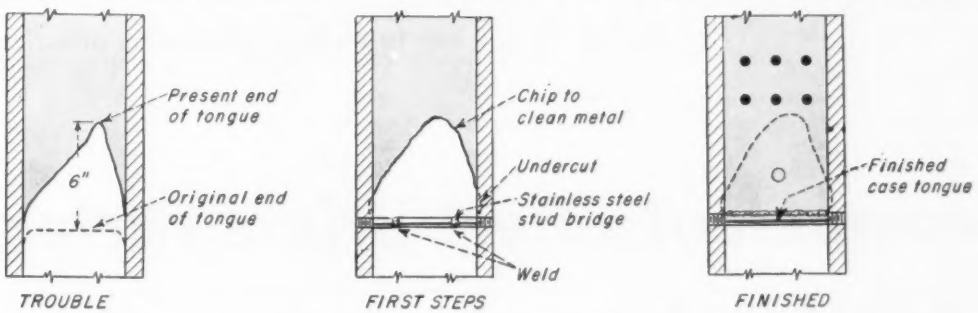


SUCTION CHAMBER has thin, hard deposit—mostly carbonates. Discharge volutes have no deposit, only graphitic corrosion

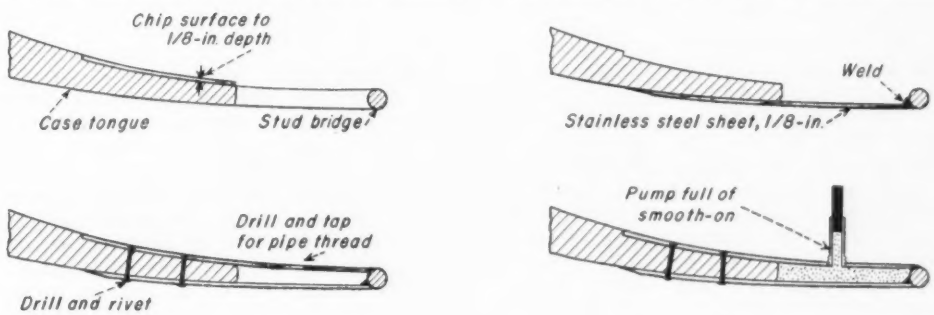


WEARING-RING seats of casings were bored for bronze inserts. Three setups per cutter head machined bore to proper shape

Step-by-step operations that gave tongues many years of useful service



Eroded discharge volutes of casing were rebuilt to original dimensions



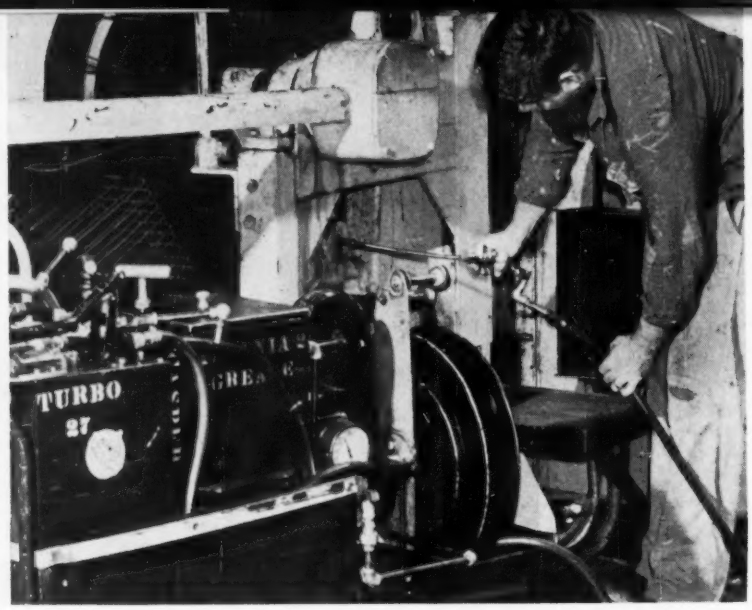
pared). We have also used new cast-iron impellers with factory applied coatings. While some spot peeling took place, we did get fair results by repairing the coating annually. On this job we experimented with paint coatings.

One pump case in each unit was selected for paint. Coating was applied to the discharge section of case only. Reason: Suction portion is protected by the thin, hard deposit.

Sand-blasting these cases in place was impossible. So surfaces were scraped to bright new iron. In one, we applied two coats of a well-known asphalt-base protective coating, designed for underwater service. On other case we used two coats of a catalytic epoxy base coating. This also is designed for submersion and high corrosion resistance. We opened units for inspection after 6000 hours of operation on the asphalt compound and 1800 hours of operation on the epoxy coating. We found almost no trace of either coating. Conclusion: We doubt if a rubber type coating will give good service on this installation.

Since completing these two high-service pumping units, we repaired the two companion low-service units in the same way. Case ring seats are slightly different in design, but general method is same. No tongue repairs were needed on these units. Expensive pumps can be saved by similar repairs.

LUBRICATION FIELD NOTES: 5



If your oiler is hep to modern lubrication practices . . .

A competent oiler: prime factor to trouble-free plant operation

► THE HAND THAT HOLDS the oil can or grease gun determines how well your machinery is lubricated. An oiler can often remedy a difficult condition if he has the right background and training.

Modern machinery is frequently complicated and often runs at high speeds. For trouble-free operation, lubricants must be applied intelligently. Merely purchasing high-quality oils and greases is not enough.

An untrained, uncomprehending worker may keep pouring oil on or packing grease in until something fails. Then he calls a mechanic for help.

Lubricant wasted. I saw an outstanding example in a plant that made small metal parts. I happened to pass through one department just as the oiler was making his rounds. One of the production machines was a small wire straightener arranged somewhat like a high-speed bench lathe. It was driven by a speed-increasing pulley and belt from overhead line shafting. The straightener spindle probably turned at several thousand rpm. It had a simple open oil cup on the main sleeve bearing.

This machine ran faster than surrounding units. I watched to see if the oiler applied the same oil that he used for the other machines. He did—and the effect was quite dramatic.

As he filled the walnut-sized cup the straightener slowed down. Oil was much too heavy and the bearing was literally flooded. Spindle ran slowly for several seconds until it heated up enough to thin the oil and let some pass through. There was even a stain stripe on the floor where oil had sprayed out from end of the bearing.

This oiler had little conception what he was doing. Otherwise he would have known he needed a lighter oil and that a drip-feed oil cup adjusted to feed one drop at a time was the correct way to lubricate this bearing. It should not have been flooded.

Bearing troubles. In a paper box plant I was asked to look at ball bearings on a glueing machine conveyor. On one side of the gluer, conveyor bearings were almost inaccessible and apparently hadn't been greased for some time. Yet these bearings had never caused trouble. But identical bearings on the accessible side were in difficulty.

The unskilled night cleanup crew did much of the oiling in this plant. No doubt they had packed extra grease into the near bearings, making them run hotter and causing premature failure.

Wrong lubricant. In another plant several large motor-driven vertical reciprocating plunger pumps are used to pump suspensions of solids. These old-timers are driven through open gearing and have large sleeve bearings on the gear and crankshafts. There's a large recessed pocket over the oil hole of each bearing cap, designed to contain waste (preferably a mixture of wool and hair) which holds oil and feeds it slowly into the bearing. Arrangement approaches a primitive drip-feed oiler and is adequate for rough bearings found on heavy machines of this vintage.

The oiler decided to improve on this very simple system and use grease. On the surface it looked fine. Pocket was filled with grease and he thought the bearings were getting lubrication. But

Here's what makes a good oiler

- Mechanical ability—a good mechanical background, preferably as a machinist or millwright
- Dependability—to work efficiently with little supervision
- Alertness—to notice and report potential trouble such as damaged gears, worn belts, overheated motors
- Understanding—to appreciate why and how much a machine should be lubricated
- Independence—to enjoy working on his own and take pride in an unglamorous but essential job
- Know-how—to read lubrication charts such as those provided by the oil supplier
- Personal cleanliness—habitual care to prevent oils and greases from being contaminated

---

he will measure up to these seven good traits

"Keep the unskilled man away from the grease guns," says this lubrication engineer. Careless oiling may spoil products, cause premature bearing failure, and waste lubricant

By **SIM JESTER**, *Product Application Engineer, Gulf Oil Corporation*

he didn't realize that a grease pocket has a wide opening in the bottom so grease contacts the journal. Heat from the journal melts grease to feed into the bearing as needed. But with just a small oil hole, only a little grease reached the bearing. The rest formed an arch and bearing was literally "starved."

When I explained this, the master mechanic saw the danger right away. He instructed the oiler to clean out the pockets and use the method for which they were designed.

Note: You cannot change from oil to grease without making sure grease can reach surfaces to be lubricated. In this case spring-loaded grease cups could have been used if the oiler had tapped threads in the bearing cap oil holes.

Spoiled products. A textile manufacturer faced considerable finished product spoilage caused by oil or grease spots. Management wanted a heavier oil that wouldn't drip. Before making my recommendation, I asked to look over the plant. I could find nothing fundamentally wrong with the oil they were using. In many departments lubrication practices were fairly good. But in the Twisting and Spinning Department things were in bad shape.

Here there were between 50 and 75 large machines. Each had 100 or more lubrication points. Some were nearly 75 years old; others had been installed within the past year. There were piles of grease under all grease-lubricated points of the older twisters. Naturally some of the bearings were pretty badly worn, but there was no excuse for such conditions. The old grease forced out of the sleeve bearings should have been wiped up instead of accumulating on the wood floor.

Furthermore, the fittings on most of the machines were covered with gobs of fresh grease. This could have been caused by several things. Possibly the attachment on the grease gun didn't match the fittings on the machine. But most of the fittings were the old push type, depending on the oiler's dexterity to make a tight fit between gun and fitting. I recommended replacing these with hydraulic or other type fittings to provide a positive seal between gun and fitting.

Even the improved fittings should be wiped before greasing to remove accumulated dust or lint. After greasing, excess grease should be wiped away. The oiler's carelessness caused moving parts of the twisters to throw grease and was one of the leading causes for spots on the yarn.

I followed this oiler while he made part of his rounds and discovered another bad practice. He had a new air-operated power gun. He hooked up the nozzle to a grease fitting and held it there 10 or 12 sec, regardless of bearing size or type. No wonder there were piles of grease under the machines!

Actually the plant would be better off if this oiler used a hand gun. If he had to pump the grease with his own muscle he wouldn't be so generous.

On another type of twister this same man oiled spindle bearings with a $\frac{1}{8}$-in. dia oil hole, using a battered spout oil can with a tip as big as a pencil. Most of the oil went on the spindle and very little in the hole. Oil spattered all over the place. Here was another good source for spots on the thread. And oil and grease on the wood floor sure would make excellent fuel for any fire that started here.

I told the manufacturer that his biggest problem was the untrained oiler. Using improved lubricants would produce little benefit until this situation was corrected. The oiler was an uninformed man who couldn't understand English. He had no experience or background to equip him for the job.

This was a case where management had underrated the importance of oiling. No doubt they eventually regretted the false economy of putting an unskilled man in a job that could cause so much finished product spoilage. This all goes to prove that oilers should be chosen as carefully as the lubricants and equipment they use.

Remember: In spite of the wide use of automatic and semi-automatic lubrication on modern machinery, many of these arrangements are only applicable to new machinery and relatively few systems are adaptable to existing equipment. Even the so-called "automatic" systems depend on humans for adjustment, checking and replenishment of lubricant.

Great bulk of machinery today relies on a manual operation to supply the oil or grease. Very little lubrication doesn't depend on the judgment and discretion of individuals. Many lubrication problems would be eliminated if this factor was considered in selecting a plant's oiling personnel.

OPERATORS' NOTEBOOK 109

Now you can shoot

What is resin-pressure splicing?

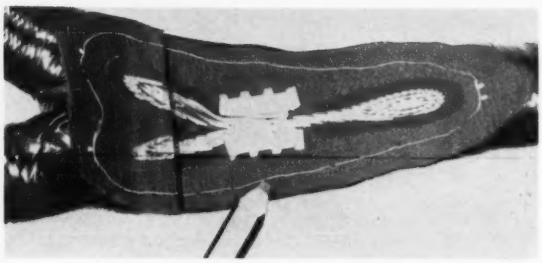
► HIGH DIELECTRIC STRENGTH and other sought-after properties suit epoxies for splice insulation. They have good adhesion to clean metal, glass and rubber. High penetration, to prevent voids, plus low moisture absorption make them ideal when exposed to weather. These qualities also make epoxies useful for underground service. Toughness, elasticity and abrasion resistance help make them stand up where thin coatings are usually used. They do well in sunlight, with salt water and boiling water. Low temperatures do not embrittle epoxy.

Epoxy resins have done well in such electrical applications as armature insulation at high temperature, vibration and corrosive fumes. They're also used on magnetic coils.

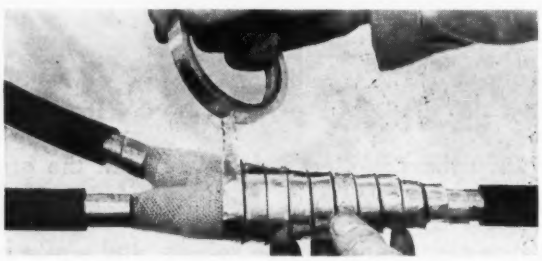
Splices. Now this new versatile shotgun method injects epoxy resin into a mold. You can tailor-make the mold on the job, as photos show. Method is known as resin-pressure splicing. It's expected to find wide usage among utilities, power companies and electrical contractors for both buried and aerial cable. Because of method's versatility, lead, rubber and plastic cable can be spliced. The 3-M Company also claims success on oil-saturated cable.

This method works with almost any kind of splice. You can regulate the needed insulating values by increasing or decreasing thickness of spacing build-up. Because each splice is custom-made, you can make shielding for shielded cable continuous through the splice by running it through the spacer tape build-up. You can also attach external grounds before applying the spacer tape. Parallel exit of cables from splices can be arranged by padding the cables into place with insulating putty before beginning splices.

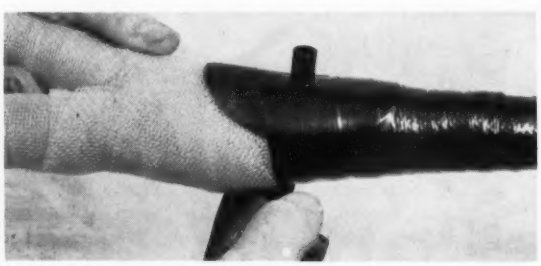
—Courtesy, Minnesota Mining and Manufacturing Company



1 Cutaway of finished splice shows perfect saturation of the resin because of resin's low viscosity before it sets. Shielding tape, jumper wires, connector and conductor strands are shown embedded in the resin. Note that the resin has even penetrated into the spaces between the conductor strands



4 Shielded cable can be continuously spliced with aluminum-foil tape. Wrap tape around first layer of spacer tape to allow for a layer of resin on both sides of the shielding

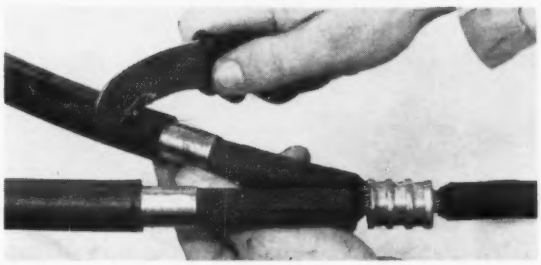


7 Apply a new layer of spacer tape until you have the right thickness. Then begin a wrap of vinyl tape and position the injection fitting as shown. Pressure-sensitive vinyl now forms a liquid-impervious seal that will contain the resin

9 After splice is wrapped, prepare resin and resin gun to shoot the splice. First position nozzle fitting with the pressure-sensitive back on the side of container. This holds the epoxy resin and catalyst in the divided compartments

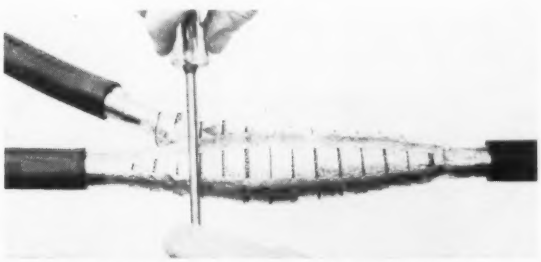
splices from a gun

By **STEVE ELONKA**, *Associate Editor*

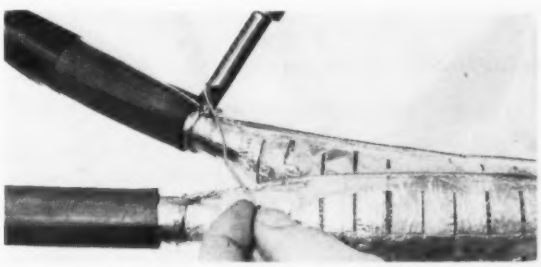


2 Prepare the cable in the usual way, using the desired connector. Scrape the cable insulation thoroughly as shown. This provides a good adhering surface for the epoxy resin

3 Now prepare cable with successive servings of grid-like spacer tape. This provides a mechanical build-up, yet allows spaces for the resin to penetrate all points in splice



5 Run strips of foil tape from shield to shield on both the main cable and branch. This insures a continuous shielding. Then iron down the foil tape with a round object as shown



6 Now you can complete the shielding by soldering the jumper wires across the splice from original cable shielding

8 With vinyl tape in place, apply wrap of fabric tape over plastic. This provides mechanical support for stretchy vinyl, similar to automobile tire and inner tube. Here vinyl tape acts as the inner tube, while the fabric tape acts as tire

10 Rupture separating membrane between resin and activator. Mix container's contents by squeezing alternate ends of envelope 30 to 40 times. Insert envelope of mixed resin into gun. With nozzle in place, squeeze trigger a few times. Puncture envelope with sharp tool. Now plastic nozzle acts as a disposable liner for gun barrel which minimizes clean-up

11 Squeeze trigger into injection fitting under high pressure until drops of resin appear through holes punched at ends of splice. After splice is full, resin sets up into a hard solid mass throughout the splice. Mass is from internal heat created by chemical action of resin. Resin sets in 5 to 10 minutes. Remove the outside fabric tape when finished, if desired

Plant

Electrical

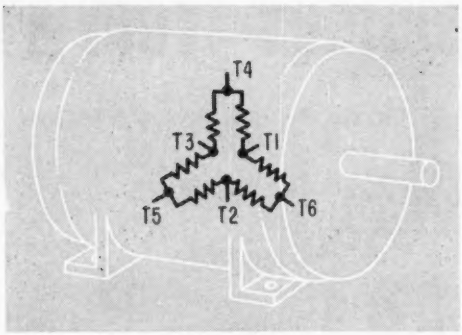
Fact File

No. 15: MULTISPEED MOTORS

10 hookups for multispeed motors

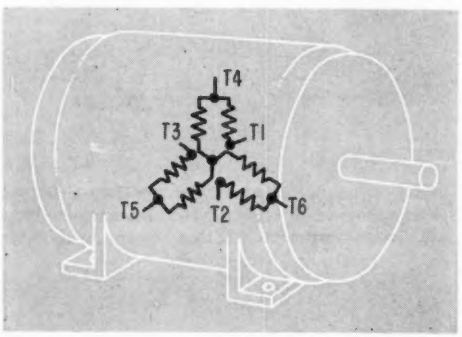
By NORMAN PEACH, *Assistant Editor*

► MULTISPEED 3-PHASE squirrel-cage motors are made for 2, 3 and 4 speeds. Two-speed motors may have two windings and can be built for any two standard speeds. If motor has one winding, slow speed is one-half high speed. Three-speed motors use one 2-speed winding and one 1-speed winding. Four-speed motors have two 2-speed windings. NEMA designs are for constant horsepower-variable torque, constant torque-variable horsepower or variable torque-variable horsepower, depending on how different loads vary with speed. In diagrams which follow, L1, L2 and L3 are incoming line leads. For any particular speed, each line lead is connected to motor terminal in column beneath it. Terminals in *open* column are insulated from each other while those in *tied together* column are connected to each other.



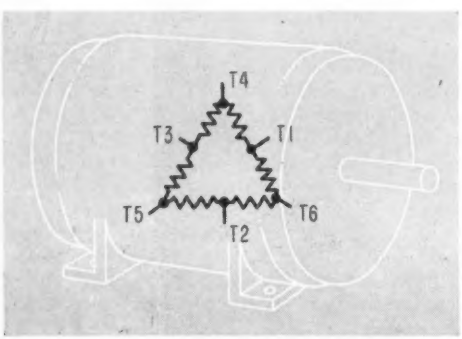
2 TWO-SPEED CONSTANT-TORQUE SINGLE WINDING

Speed	L1	L2	L3	Open			Tied together		
Low	T1	T2	T3	T4	T5	T6			
High	T6	T4	T5				T1	T2	T3



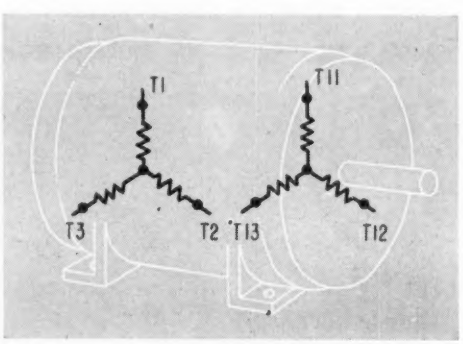
3 TWO-SPEED VARIABLE-TORQUE SINGLE WINDING

Speed	L1	L2	L3	Open			Tied together
Low	T1	T2	T3	T4	T5	T6	
High	T6	T4	T5	T1	T2	T3	



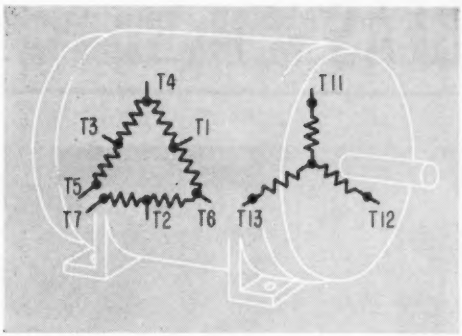
1 TWO-SPEED CONSTANT-HP SINGLE WINDING

Speed	L1	L2	L3	Open			Tied together
Low	T1	T2	T3	T11	T12	T13	
High	T11	T12	T13	T1	T2	T3	



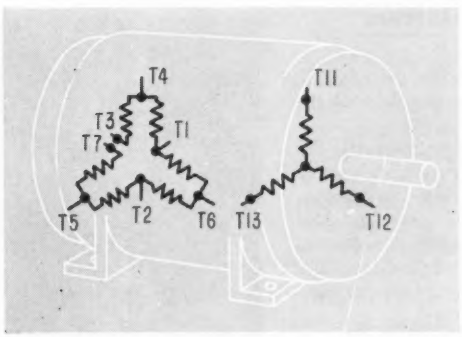
4 TWO-SPEED CONSTANT-HORSEPOWER AND CONSTANT-TORQUE WITH DOUBLE WINDING

Speed	L1	L2	L3	Open			Tied together
Low	T1	T2	T3	T11	T12	T13	
High	T11	T12	T13	T1	T2	T3	



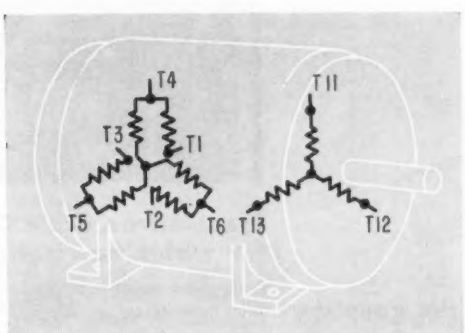
5 THREE-SPEED CONSTANT-HP DOUBLE WINDING

Speed	L1	L2	L3	Open	Tied together
Low	T1	T2	T3	T11 T12 T13	T4 T5 T6 T7
Medium	T11	T12	T13	All others	
High	T6	T4	T5 T7	All others	



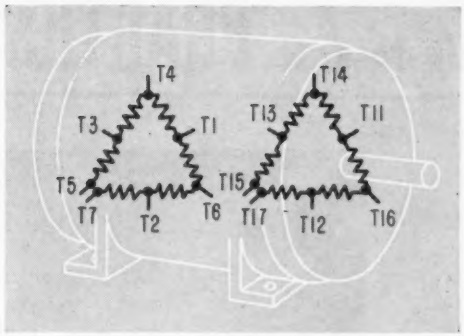
6 THREE-SPEED CONSTANT-TORQUE 2 WINDING

Speed	L1	L2	L3	Open	Tied together
Low	T1	T2	T3 T7	All others	
Medium	T11	T12	T13	All others	
High	T6	T4	T5	T11 T12 T13	T1 T2 T7



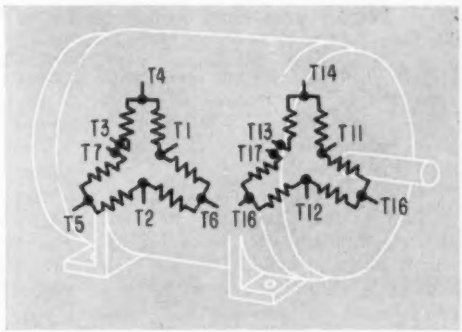
7 THREE-SPEED VARIABLE-TORQUE 2 WINDING

Speed	L1	L2	L3	Open	Tied together
Low	T1	T2	T3	All others	
Medium	T11	T12	T13	All others	
High	T6	T4	T5	T11 T12 T13	T1 T2 T3



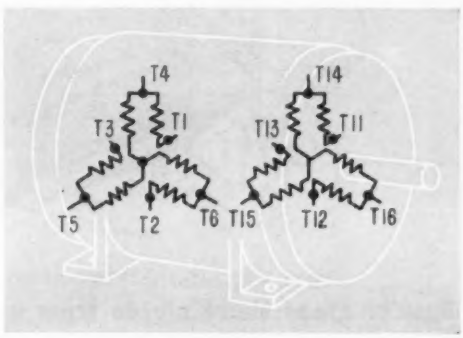
8 FOUR-SPEED CONSTANT-HP DOUBLE WINDING

Speed	L1	L2	L3	Open	Tied together
Low	T1	T2	T3	T11 to T17	T4 T5 T6 T7
2nd	T11	T12	T13	T1 to T7	T14 T15 T16 T17
3rd	T6	T4	T5 T7	All others	
High	T16	T14	T15, T17	All others	



9 FOUR-SPEED CONSTANT-TORQUE 2 WINDING

Speed	L1	L2	L3	Open	Tied together
Low	T1	T2	T3, T7	All others	
2nd	T11	T12	T13, T17	All others	
3rd	T6	T4	T5	T11 to T17	T1 T2 T3 T7
High	T16	T14	T15	T1 to T7	T11 T12 T13 T17



10 FOUR-SPEED VARIABLE-TORQUE DOUBLE WINDING

Speed	L1	L2	L3	Open	Tied together
Low	T1	T2	T3	All others	
2nd	T11	T12	T13	All others	
3rd	T6	T4	T5	T11 to T16	T1 T2 T3
High	T16	T14	T15	T1 to T6	T11 T12 T13

Up-to-date PRACTICAL IDEAS *to lick some of your*

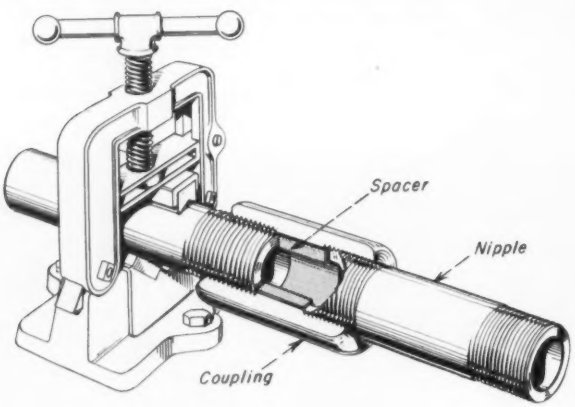
Now, you can keep quiet with noise blotters

If your plant has places where noise frays nerves and reduces efficiency, 'noise blotters,' photo, will sop up a large amount of clamor. Just hang them from the ceiling.

Blotters are flat pieces of aluminum, perforated and laminated to fiber blanket, with embossed lines for assembly into a pyramid. They give you a portable acoustical system that can be salvaged or moved when noise sources are eliminated. One *Acoustosorber* serves 12 to 16 sq ft of ceiling space. They are usually extended 12 to 20 ft in each direction beyond the noise area.

These blotters have an unusually flat absorption curve and a very high sound absorption in the low frequencies where most acoustical materials show poor absorption. Aluminum units can be washed in place, or taken down and washed to reduce maintenance of such a system to a minimum.

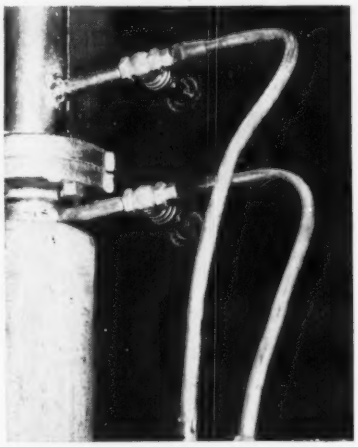
Courtesy, The Aluminum Association, 420 Lexington Ave, New York, N. Y.

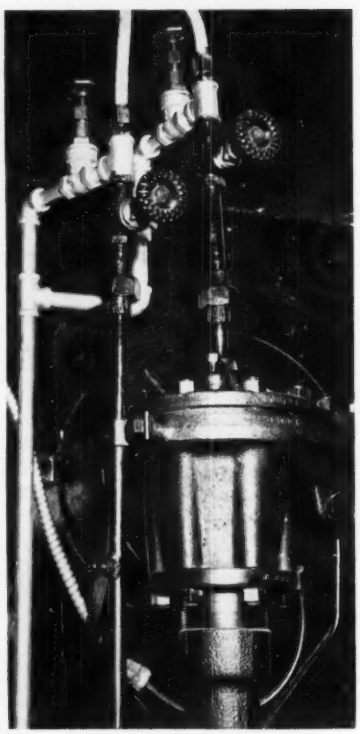


Spacer stops short nipple from expanding the coupling

When threading short nipples, make a short spacer from pipe to place between nipples as shown. This prevents short nipple from expanding the coupling and getting wedged so tight that you often distort nipple when removing with pipe wrench. You can make a set of these bushings or spacers to fit your various sized nipple needs. Once you use them, you'll wonder how you ever got along without them.

A CAMACHO, *Cebu City, P. I.*





Trouble-free drain line for water flowmeter

Inaccurate water-flow readings can be from restriction in the water connections of the primary element. But inaccuracy is not easily noticed since the restriction is usually caused from rust forming slowly on pipe openings in the water line.

Top photo shows a typical installation on a vertical rise between the

makeup tank and feedwater heater. During periodic maintenance, we had to disconnect the tube fittings and insert a rod past the gate valves into the openings. That broke up the rust formation. Then flow of water following this action washed out the foreign material.

This was not too satisfactory because of fitting location. So we installed drain connections in both high and low side. Connections are at flowmeter, as shown by the aluminum painted pipelines and fittings in lower photo. Drain line leads into an open drain where visual inspection is made. Now we close the two black-painted meter valves and open the other two valves at same time to learn flow condition of each side. This maintenance job is done once a month. Our water flow metering is thoroughly dependable now. There are no inaccurate readings as before.

P BRASSINE, *Seattle, Wash.*

Soap finds bad hydrogen leaks

It seems everyone with a hydrogen-cooled generator is concerned with the amount of hydrogen makeup on his machine. We keep a record of ours, which runs 400 to 600 cu ft a month. This is on a 15,000-kw generator, at ½-psi pressure. In summer, when temperatures rise, we raise the hydrogen pressure. Then our makeup rises. At 5 to 6 psi, amount lost jumps to 1500 to 2000 cu ft a month.

Last summer we developed leakage and our usage rose very high. We removed part of the generator casing as soon as we could shut down. Then with H_2 pressure in machine, we soaped all joints, gaskets, plugs, etc.

Some pretty bad leaks showed up, especially on the oil-sight glasses from the H_2 scales. We repaired all the leaks we could find. When restarting the plant, we put 10-in. mercury-hydrogen pressure on the machine. This was on Oct 26, 1956. On Jan 8, 1957, 74 days later, we hadn't added any hydrogen and still had 6.2-in. of mercury pressure on the machine. The bottles are all shut off too, so we know we're adding no hydrogen. Now we can see what we would have saved had we gotten out that can of liquid detergent and our paint brush sooner. These systems can be made very tight.

K M WHITE, *Chamois, Mo.*

What would you have done?

Plant was designed and built for a natural-gas-compressor station. There were four identical L-type, 2-stage gas-engine-driven compressors. They discharged into a common 30-in. diameter main at 300 psi. One, two, three, or four compressors could be cut in, or out, as the load varied.

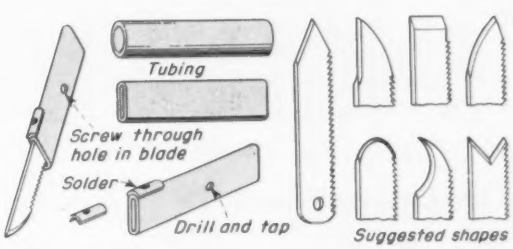
Although governor controlled, the compressors did not run at exactly the same speed of 265 rpm. This caused a cyclic synchronism of impulses from the compressor discharges as the engines periodically approached the same running positions. At this point, pulsations in the gas were at a maximum, as were vibrations of discharge pipe and noise.

There was some vibration in the intake pipe for a similar reason, but it was minor. Because the discharge pipe had been laid in saddles to float only with one anchor on an 800-ft U run, lateral mechanical vibration of the pipe reached the high amplitude of ⅝ in. This wasn't good. The project engineer had been cautioned about this possible condition. He merely wrote a long report, offered no solution.

Company called in a consulting engineer who made measurements of vibration amplitude and reported on the probable causes of vibration. But he also failed to offer a cure or suggestion for compensation.

My recommendation was to set two additional solid anchors and a continuous series of confining supports, which was done. Vibration dropped to ⅛-in. maximum amplitude. What would *you* have done?

H M NEUHAUS, *Philadelphia, Pa.*



Put your old hack-saw blades to work

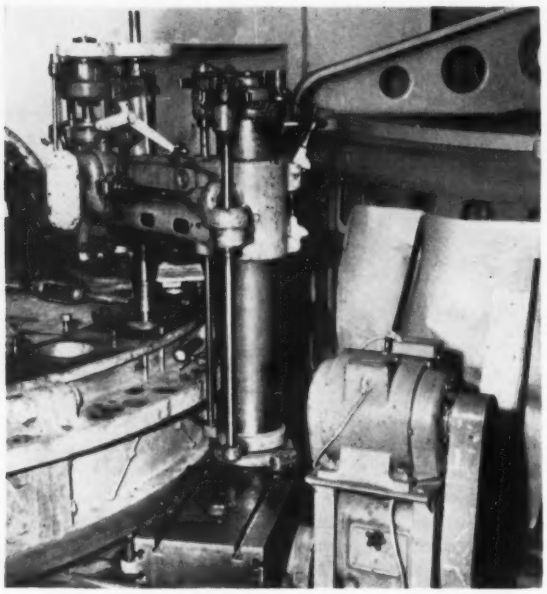
Don't throw good hack-saw blades away when worn or broken. They are made of excellent tempered steel and can be put to good use. Various types of small blades, above, are easy to make. First make one of the good durable handles, above, from flattened copper, brass or mild steel tubing. Use blade section that has a hole in one end so you can secure it to handle. Then tighten the screws and your blade is secure.

C H WILLEY, *Penacook, N.H.*

Turn page for more Practical Ideas ▶

More PRACTICAL IDEAS

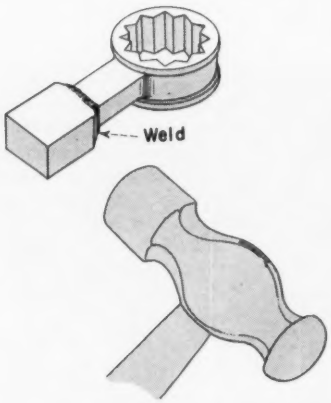
Begins on page 130



Why try moving the mountains?

Recently, while overhauling a turbine, we found the headcover holes—which take the bronzes for the wicket-gate stems—worn oval by about ⅛ in. Since new bushings were needed throughout, it would have been silly to try to fit round bushings into oval holes. Also, it would have been a costly job to load and ship such a heavy piece of machinery to an outside shop. By uprooting the radial drill press from our shop and installing it as in photo, above, holes were rebored with a fly-cutter.

L McWILLIAMS, *Shawinigan Falls, Que.*



Short lug wrench is handy

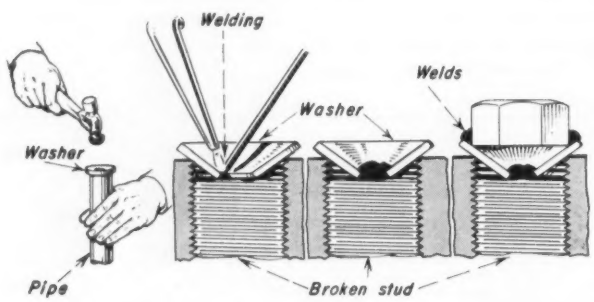
You can convert any star-type box wrench into an extremely handy hammer blow wrench for close quarters or for stubborn nuts. Cut off the conventional wrench and weld a lug onto it as shown. Try it for those tight places.

C H WILLEY, *Penacook, N. H.*

Need new tackle?

DID YOU EVER get a check from POWER? It's easy. Just send me your latest practical improvements. Add sketches, photos, or both. You'll receive a check for each idea I accept. Some readers get these checks every month. Don't let your fish down; send me your ideas today.

When submitting anything for publication, type (write or print) *double space* to give editor space between lines for editing. This saves time.—*Steve Elonka.*



Here's a hot idea for removing broken studs. Try it!

Removing a broken stud can be a headache. One problem of welding a piece of bar stock to stud is to keep weld from bonding to threads in casting, especially if stud diameter is small. Sketches show how I licked problem.

To remove a ⅝-in. stud that's broken below the surface, take a ½-in. washer, place it over end of ¾-in. pipe and hammer into a cone shape with ball-peen hammer. Then place cone over stud and weld to stud. Make sure washer is coned enough to rest on broken stud end. This keeps all bonding away from threads.

It's best to hold washer while welding so it doesn't move while striking arc. I find a stainless rod gives a strong bond. Next, weld a nut to the washer and you're in business. This beats any other way of removing studs.

G S GRAVES, *Brooklyn, N. Y.*

Did you know . . .

that new *Plant Operators' Manual,* McGraw-Hill Book Co, has more practical information for plant operators than any book yet published? Over 1500 illustrations actually *show you* everything from aligning bearings to the correct way to make a boiler inspection.

Turn page for more Practical Ideas ►

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STYLE 804

To Withstand High Pressure Superheated Steam or Hot and Dry Gases

Stays Soft and Resilient

You will find many uses for this superior Anchor braided asbestos packing, which is available in ring, spiral and coil. It is known to industry as 804 packing.

Ankorite 804 is a pure asbestos graphite plastic core packing having an outer jacket of closely braided high quality asbestos yarn. The jacket is reinforced with monel metal wire.

As Ankorite 804 will stay soft against high pressure and high temperature conditions, it is the ideal packing against high pressure, superheated steam, or for hot and dry gases, as well as many other uses.

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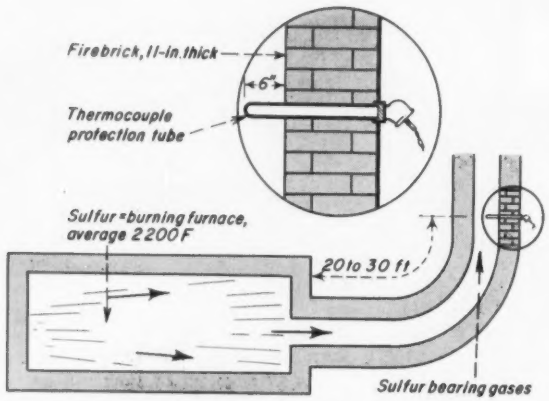
More PRACTICAL IDEAS

Begins on page 130



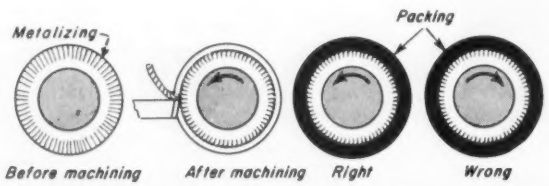
Now, thermocouple tube stands up in 220-F sulfur-bearing gases

Back in 1954 we installed a Haynes metal ceramic thermocouple protection tube in a sulfur-burning furnace. Still in use, it has stood up to 2200-F average temperature, mechanical and thermal shock. It also provides the least temperature lag of any tubes tried for the job.

Basic reason for the protection tube to have a strong receptacle for the sensitive temperature gaging instrument. Tube also permits rapid and exact temperature checking. This information is valuable for estimating the highest possible production, while minimizing the danger of letting temperature rise high enough to slag the furnace brick or damage other parts.

All other material failed because of (1) too great a time lag—some as much as half-hour (2) failure from breakage or shock (3) failure of material caused by high temperatures; also from SO_2 furnace atmosphere. Sketch, above, shows the complete details.

Courtesy, Haynes Digest



How about this new idea on metalized shafts?

We rebuild large worn bronze packing sleeves of centrifugal pumps by metalizing with stainless steel. As most maintenance men know, metalized coating consists of numerous slightly oxidized interlocked particles, keyed into each other. We found a definite improvement in packing and sleeve life when machining metalized surfaces in direction of pump's sleeve rotation.

As sketches show, granular structure of sprayed metal causes surface particles of sleeve to physically deform while turning or grinding. I find this true regardless of how smooth the surface may appear. Where the sleeve is turned and ground in opposite direction to its rotation in service, the interference and grain is against the packing. When machined in direction of shaft rotation in pump, packing and sleeve lasts much longer.

EMIL WHITTMAN, *Cape May, N. J.*

Editors' Note: Emil Whittman brings up a very interesting point that no thought has been given to as far as we know. Do you readers have any actual experience to back up Mr Whittman's theory? Let's hear from you. Yes and no, says one manufacturer . . .

Here's one answer: (1) Direction of rotation makes no difference with a perfectly ground or a perfectly machined surface. (2) It's unlikely there would be any difference, with most metals, or any grind job unless it was very poorly ground with a dull or glazed wheel. (3) It could make a difference, perhaps a very great one, on an average machined job. Nearly all operators try to get a bright shiny machined surface. You can only do this with a tool edge that does a certain amount of burnishing or 'smearing.' Smeared surface grains are attached on the advancing side, loose on the retreating side. So grains could raise up and chew things if rotation in service is counter to rotation while machining. This idea is interesting.

Maintenance Co, St. Louis, Mo.

Try this edge trimmer

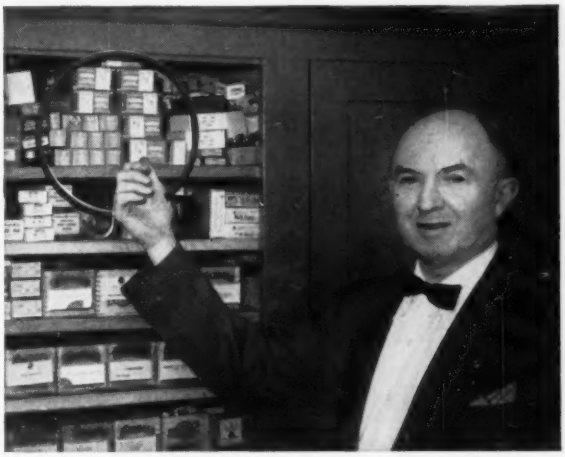
Safety-razor blade and block of wood with an adjustable sheet-metal guide makes a very handy tool for trimming drawing paper, sheet stock, packing, plastic, thin aluminum, etc. Use on a trim board with a square edge. Line up material to be trimmed with the board's edge. Hold material with weighted pieces. If a long flat piece is handy, clamp it against work. This tool is tops for cutting up hide strips.

C H WILLEY, *Penacook, N. H.*

My biggest boner

Please turn to page 236

"they're easy and simple to take care of"



"Spare parts for a whole plantful take only a corner of a cabinet."

Q. Mr. Baker*, as Superintendent of Plant and Structures of the Newark Beth Israel Hospital, you've used a good many Yarway Impulse Steam Traps in the last 20 years. What, in your opinion, are their main advantages?

A. The big thing is that they're easy and simple to take care of. In many cases, they can replace traps much bigger and heavier. Then, too, they seldom give us any trouble. Usually we install 'em and forget 'em. When they do need service, replacement of the little valve is the worst that can happen, and that only takes a couple of minutes.

Q. What do your operating men think of Yarway traps?

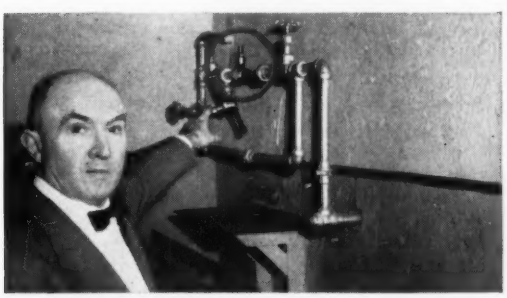
A. Twenty years ago, when the Yarway Impulse Trap was introduced as a new idea in steam traps, it made sense to me and I ordered some. My men, however, insisted they wouldn't work. I finally put on a demonstration on a steam leg down in the boiler room, and they were convinced. Now they are as enthusiastic as I am.

Q. How many Yarway Impulse Traps are installed around the plant?

A. I don't know exactly. They're all over the place. Certainly over 100. We have them throughout the laundry and kitchen, on all the steam tables and coffee urns in the cafeterias, in the operating rooms and Central Supply on sterilizers, autoclaves and stills, in the boiler room on fuel oil heaters, high and low pressure lines, and on steam line drips everywhere in the plant. To service all these, our inventory of spares and repair parts takes, as you can see, only a little corner in a filing cabinet.

Q. We notice a few traps of other makes around. How do you explain that?

A. Well, some equipment gets installed with other traps on it—but first excuse we get, we replace 'em with Yarways!



"This Yarway Impulse Trap on drip line replaced a conventional trap that needed a platform to support it."

If you would like a copy of a new, helpful booklet, "The Why and How of Steam Trapping" drop a card to

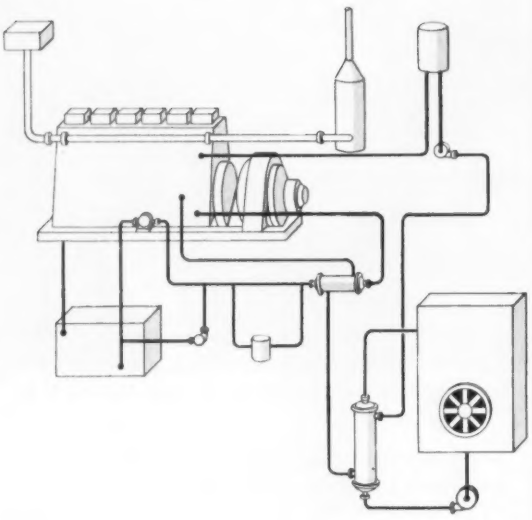
YARNALL-WARING COMPANY
100 Mermaid Ave.,
Philadelphia 18, Pa.

**GEORGE E. BAKER, Supt. Plant and Structures, Newark Beth Israel Hospital, Newark, N. J.*

YARWAY impulse ...a good way to specify steam traps

OVER 1,200,000 YARWAY IMPULSE STEAM TRAPS ALREADY USED • STOCKED AND SOLD BY 275 CONVENIENT LOCAL INDUSTRIAL DISTRIBUTORS • NATION-WIDE YARWAY ENGINEERING STAFF AVAILABLE FOR SERVICE.

Have a PLANT PROBLEM? *Tap the*



The problem

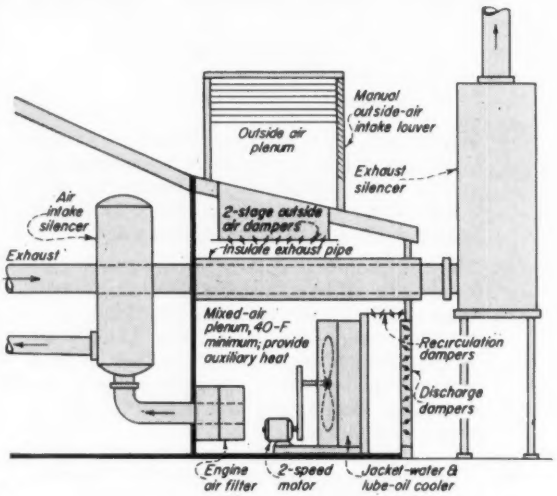
How can we design diesel cooling for cold-weather operation?

We have a diesel-electric plant that uses four 1200-hp diesels and direct-coupled 912-kva generators. Diesel cooling is with evaporative water coolers.

Our plant is in an area where outside air temperatures fall to 30 F below zero, with strong winds. If outside air is used to circulate through the evaporator there is danger of freezing the coil; the spray pan fills with ice and the intake plugs with frost. If inside air is used, the full use of spray water is required during peak winter loads. This causes excessive ice build-up below the evaporator discharge. Unless constantly chopped away, it plugs the outside air inlet and causes water to leak into the building.

We want to design a system that will permit us to operate the evaporators and, at the same time, eliminate the above problems—*RRL, March Power*

The solutions



Use air-cooled jacket-water and lube-oil coolers

RRL should junk his evaporative coolers and install an air-cooled combination jacket-water and lube-oil cooler for each engine. Coolers should be designed for maximum outdoor temperature and have a two-speed fan for varying outside air temperatures.

Recently a cooling system was redesigned for a plant equipped with three 1000-kw diesel generators. Outside temperatures in this area vary from 90 to –60 F. Evaporator coolers in old system were fouled by poor water. Thus, operators had to use sprays even in coldest weather. Result: Water vapor pulled into the intakes and froze. Intake pipes were finally blocked solid. Frost crystals accumulated on all air intakes to the building.

A two-speed fan, combination jacket-water and lube-oil cooler and engine air-intake filter were installed in a shed to prevent freezing of cooling system and frosting of air intake, drawing above. The air-intake silencer reduces noise and pulsations in the building. Thermostatically operated dampers maintain desired temperature in the plenum and engine cooling system. Dampers adjust flow of outside air to the cooler and engine air intake.

Here's operating sequence: (1) Fan starts on low speed. (2) First stage of outside air damper opens to minimum position to supply combustion air to the engine. (3) Outside air louvers are opened manually. (4) Engine starts. (5) As engine cooling-water temperature rises, recirculation and discharge dampers operate along with second stage outside air damper.

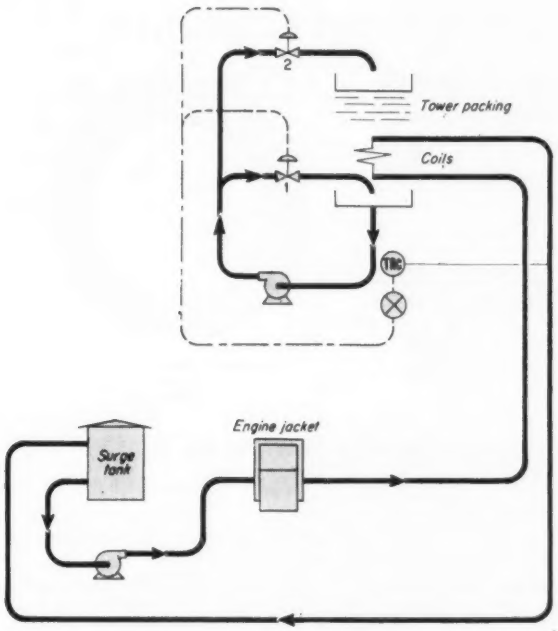
Caution: Don't use this design in a sheet iron building because even good intake silencers may not prevent the walls from pulsating. And be sure the system can spare the extra auxiliary power required for operating the cooling fan.

If *RRL* uses this system he should have a competent engineer prepare the design in cooperation with the engine manufacturer and control specialists.

J S MILLER, *Seattle, Wash.*

know-how of over 45,000 Power readers

HOWARD KALLEN, Associate Editor

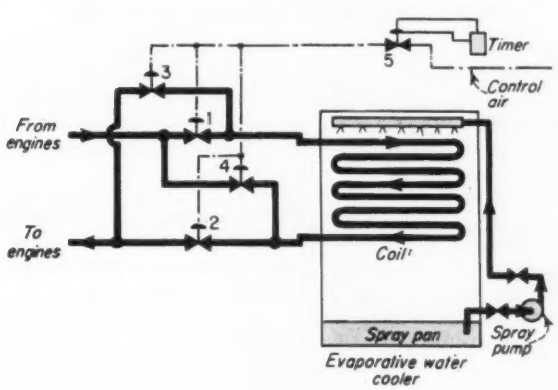


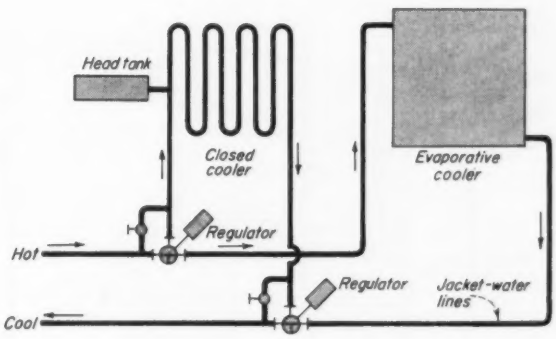
Minimize ice formation by reducing air circulation

The easiest way to minimize ice formation in a cooling system is to reduce air circulation. This can be done by shutting down fans or covering upwind side of tower with canvas.

Second step in reducing ice formation is to lower water rate over the top of the cooling section. This can be done with the setup shown above. The temperature controller is installed so the engine jacket water to the surge tank is maintained at a constant temperature. Arrangement by-passes water through valve 1. For example, if we assume that water from the tower is getting warmer, controller is arranged so valve 1 throttles the by-pass flow rate. Valve 2 opens, allowing water to circulate over tower and coils.

R E Driscoll, *Channelview, Texas*





Add closed-design water cooler

By the addition of a closed-type water cooler to his evaporative units, *RRL* can avoid his troubles. The unit can be finned-tube or multiple pipe-coil construction.

The closed cooler should be designed to carry full load at a few degrees above the point at which the evaporative unit begins to give trouble. The closed cooler can be installed so the fan is used when the closed system is in service. Added advantage: *RRL* can get some extra cooling in summer months by using the closed unit on the by-pass in connection with the regular system.

If coldest weather causes excessive cooling or danger of freezing coils, hot jacket water can be heated with a waste-heat boiler. Water in the coils would then return at the right temperature, eliminating the possibility of bursting the cooler.

System can be operated manually or it can be instrumented to run automatically, sketch above. Dependence on operators can lead to trouble if the cooling system needs attention when operators are busy with some other phase of plant operation. Automatic controls would require simple temperature sensing elements only.

B B Brown, *Williamsport, Md.*

◀——This hookup does the job

Control valves 1 and 2 are normally open during warm seasons and are the fail-open type. Valves 3 and 4, for alternate routing of supply and return water around valves 1 and 2, are for periodically reversing water flow through the cooling coil when ice forms on the coil. Valves 3 and 4 are the fail-closed type.

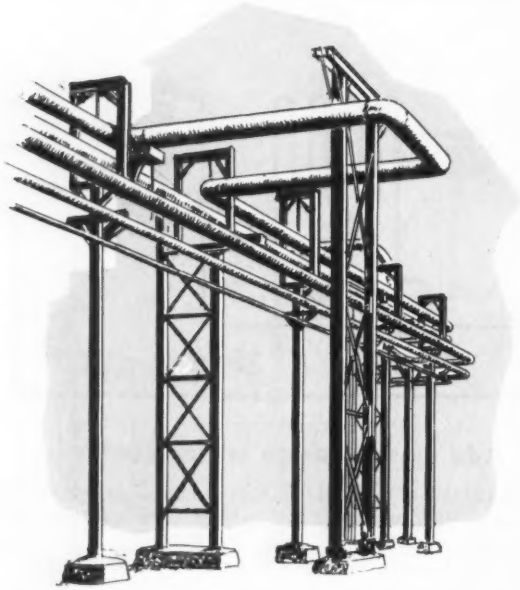
RRL could also install a timer as shown, with solenoid valve 5, controlling air flow to the diaphragms. The timer can open and shut off air flow to the diaphragm valves in accordance with outdoor air temperature reversing water flow through the coil. Hot water entering the normal discharge end of the coil will melt ice formed here during previous flow cycle.

A 50% solution of ethylene glycol in the spray pan will prevent evaporator-cooler water from freezing.

A J Breugelmans, *New York, N. Y.*

Turn page for info on insulating expansion joints ▶

More PLANT PROBLEMS Begins on page 136



The problem

How can we provide expansion joints for pipe insulation?

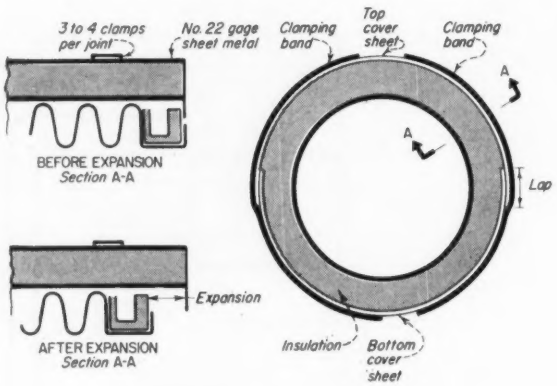
My company, as industrial insulation contractors, has been faced with the problem of expansion on pipelines operating from 700 to 1000 F.

On runs of 50 ft or more, expansion becomes a problem, particularly when the mechanical contractor uses expansion joints rather than expansion loops. We have tried several methods of expansion jointing our insulation. Sliding metal sleeves packed with insulation, both for single- and double-layer insulations, were not very successful.

To complicate the problem, the weatherproof jacket is firmly attached to the exterior of the pipe insulation, leaves no room for movement.

On the jobs we handle, steam piping runs of 1000 ft are not uncommon. Do readers have a solution to this thorny problem?—*RJA, March Power*

The solutions



Here's how I'd do it

Following the drawing, above, anchor one end of the joint's cover to the stationary end of the expansion joint. The other end is free so it doesn't hinder movement of the flange and corrugated sections.

Place the necessary thickness of block insulation over the joint encasement. Build up block or use a molded section pieced together around the expansion joint casing. When the insulation is in place, add an outer cover of 22-gage galvanized sheet iron in two layers—top and bottom —as shown above. The lap should be about an inch or more below the center line to shed any condensation that may accumulate on the joint.

The sheet metal is held in place with a strap. *RJA* can get a tool that cuts, draws, tightens and shears the strap. About three or four of these bands hold the cover in place. He can also use a small clamp to finish the final edges of the strap and keep sharp edges from cutting clothing.

As shown in sketch, when the joint expands, the double covering holds insulation in place. Since the overhang isn't more than 7.5 inches, the joint requires no further maintenance unless it is deliberately disturbed.

W P KEARNEY, *Fort Lee, N. J.*

Use clamp with support stirrups

An insulation expansion joint that would work for *RJA* is one consisting of a clamp and support stirrups. Clamps, of same material as the pipe, are attached at 15-ft intervals. Stirrups attached to the clamp are located circumferentially at a spacing that depends on the width of the insulation segments.

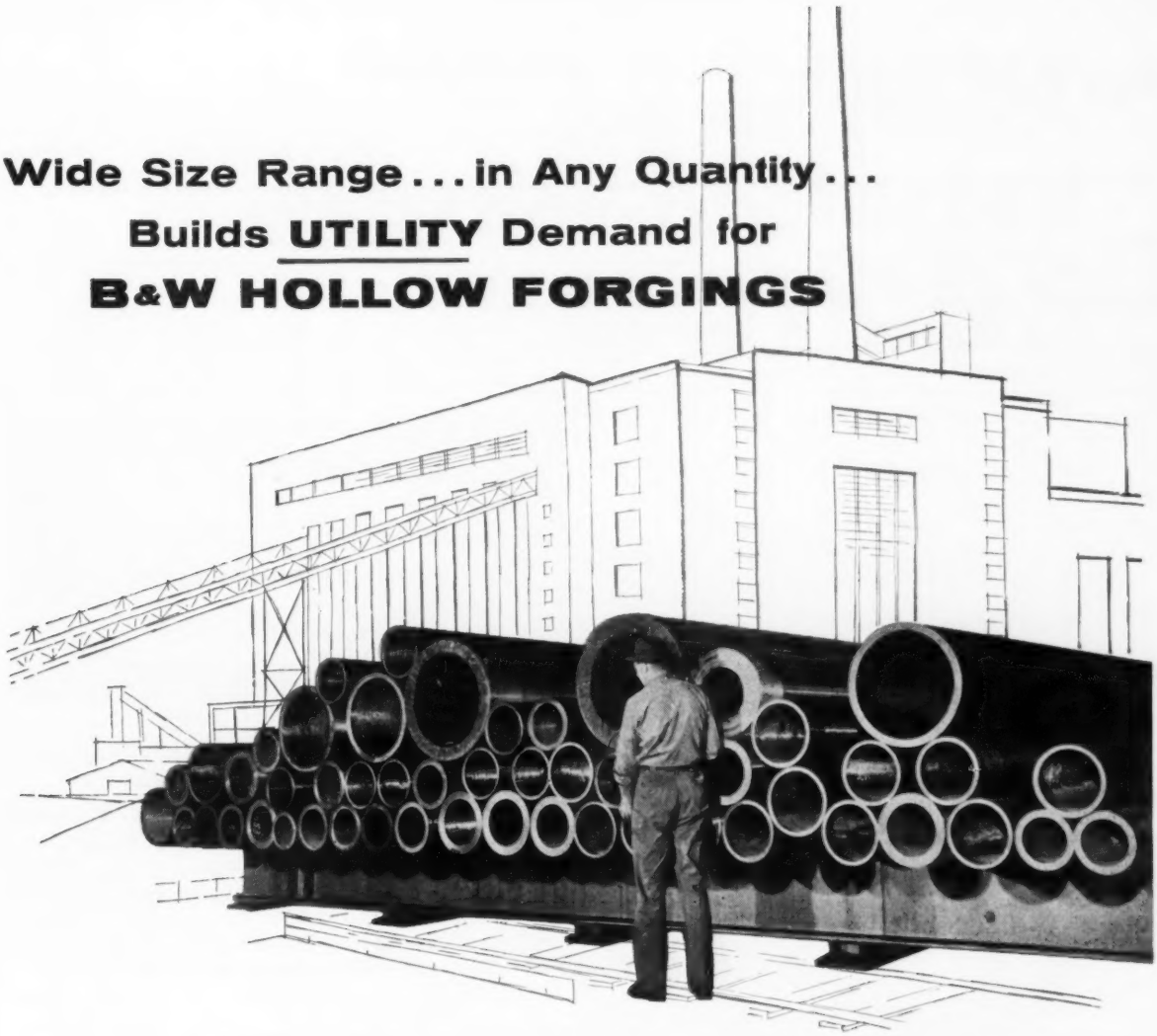
End of stirrup is bent at a 90-deg angle to support the outer layer of insulation. Joint between the outer layers is then filled with a finishing cement. The two layers should be installed to have each segment of the outer layer covering the joints between segments of the inner layer.

As the pipe expands and contracts, the stirrups will move the insulation accordingly.

A J BREUGELMANS, *New York, N. Y.*

For more on insulating expansion joints and new problems, turn page ▶

Wide Size Range . . . in Any Quantity . . .
Builds UTILITY Demand for
B&W HOLLOW FORGINGS

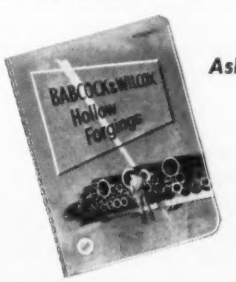


Leading Electric Utilities—like American Gas and Electric, Carolina Power & Light, Commonwealth Edison, and Wisconsin Electric Power—use B&W hollow forgings for main steam, reheater, feedwater, and similar lines. B&W hollow forgings give them a sound solution to their piping problems.

These heavy-duty forgings can be specified to exact design requirements. They are made from high quality carbon, alloy, and stainless steels. They are produced with vigilant care under controlled conditions from the initial melt through final inspection. That's why B&W hollow forgings give users savings in time and money.

Because of B&W's specialized manufacturing process, hollow forgings can be made in special shapes or with special end preparations, such as end closures, reduced sections, and Van Stone flanges.

For additional information, write for Bulletin S-16B. The Babcock & Wilcox Company, Process Equipment Department, P-6, Barberton, Ohio.



Ask for this Bulletin: S-16B

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BOILER DIVISION

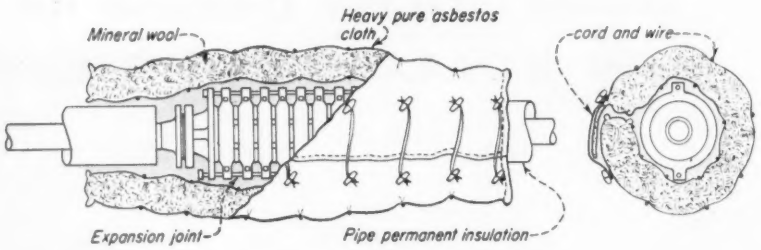
S-466-HF

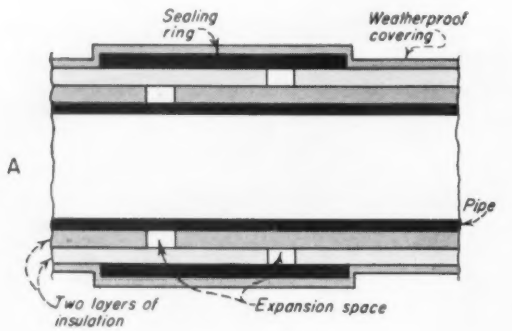
More PLANT PROBLEMS Begins on page 136

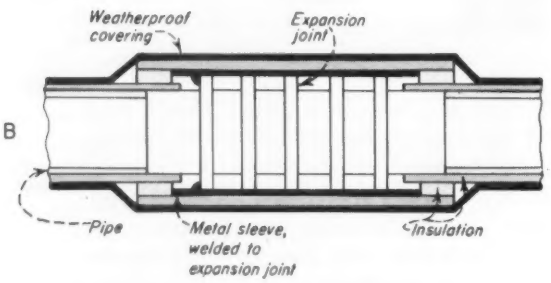
Wrap mineral wool around the expansion joint

Drawing at right shows how I'd do the job. If piping system is exposed to the outdoors, paint the outside of the asbestos cloth with a good weatherproof and heat-resistant paint.

J BORESTA, *W Englewood, N. J.*







This design allows joint movement

Sketch *A*, above, uses a space between adjacent sections of insulation to permit movement. The weatherproof jacket is applied to the outside of the insulation and isn't subjected to stress resulting from pipe and insulation expansions. Sealing ring is the same material as insulation and must be long enough to cover the distance between the extreme movement of the insulation sections.

Sketch *B* shows insulation applied to an expansion joint. A thin metal sleeve is brazed or welded to one corrugation of the joint. Insulation is applied around the sleeve and lapped over adjacent insulation on the pipe, without contacting the mechanical joint.

H B WAYNE, *Woodhaven, N. Y.*

Your June problems

How fast should steam mains be warmed up?

I recently came across a problem on which I'd like to get the thinking of *Power* readers. Essentially it's this: At what rate should long large-diameter steam mains be warmed up in order to avoid excessive pipe stresses and possible damage to the main itself? What would be the safe rate for 100 ft of 24-in. diameter, schedule-80 pipe? Steam is at 750 psig, 720 F.

Are there any rules of thumb that I can use? What factors affect safe warm-up rate?—*CV*

What's best way to heat lube oil for testing?

We've been using 5000-w 230-v carload heating units in testing oil cylinders and tanks. The units heat lube oil to 350-400 F before oil enters test specimens.

These calrod heaters have been carbonizing from contact with the hot oil. Result is a heavy coating on the rods after they've been used for a period of time. Coating reduces heating efficiency and causes nonuniform oil temperature. We've been cleaning the carbonized coatings periodically, but this is a nuisance. And it doesn't really solve our problem.

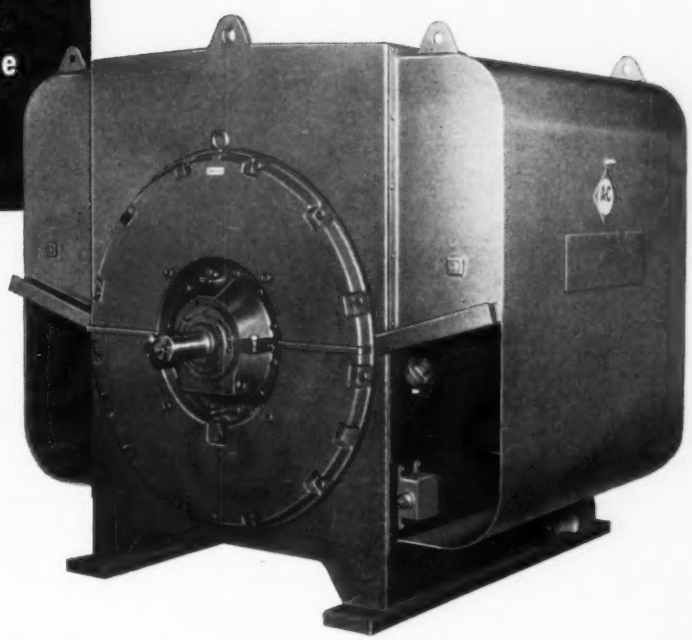
Have *Power* readers had similar problems? Are there better ways to heat oil to high temperatures so carbonizing can be eliminated?—*THC*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos, sketches.

Want help with your plant problems? Send your design and operating headaches to us. We'll put *Power* readers to work on them.

Eliminate costly enclosures with Allis-Chalmers weather-protected MOTORS

Modern features cut operating, maintenance expense . . . give MORE dependability



Here's a newly designed line of Allis-Chalmers weather-protected motors with the ability to "take" outdoor conditions. This means no expensive protective enclosures are needed . . . a big saving in plant or installation building costs.

Designed to meet defined NEMA requirements, these motors incorporate many important features which assure dependable outdoor operation:

- **Ventilating System** — Low velocity intake, vertical lift, change of direction and high velocity discharge of ventilating air keep rain, snow, sleet, dust and dirt out of vital parts.
- **Removable Air Ducts** — To facilitate inspection and maintenance of interior air passages, air intake ducts are designed for quick removal.
- **Stator Assembly** — Removable as a unit, it simplifies maintenance and minimizes downtime.
- **Split Sleeve Bearings** — Capsulized design permits access to motor interior without disturbing the bearings or their enclosures. Positive vapor seal is used on high-speed motors. Antifriction bearings are available for slow speed motors.
- **Proven Insulation** — Famous Allis-Chalmers insulation systems (Class A and B) are available. And, for extreme temperatures, or where high resistancé to abrasion and moisture is required, Allis-Chalmers can provide the revolutionary *Silco-Flex* system.

Silco-Flex is an Allis-Chalmers trademark.

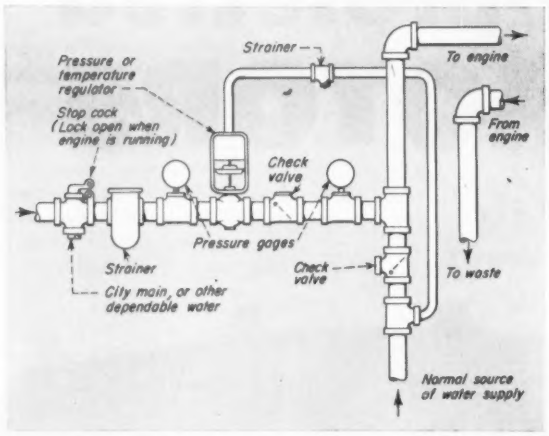
THIS DESIGN available in ratings from 250 to 900 hp. Other designs in larger horsepower ratings are also available. Contact your A-C sales office or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin. Ask for Bulletins 51B8606A and 05B7894.

A-5292

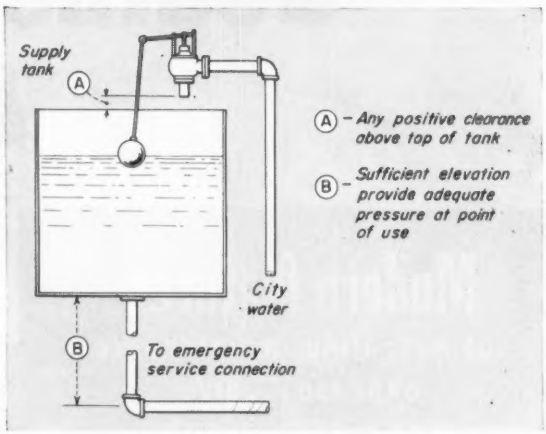
ALLIS-CHALMERS

ARGUMENTS . . . *let other readers know your views*

ALTHEA THORNTON, *Assistant Editor*



POTENTIAL DANGER of contaminating city water exists here


Supply tank
A
B
City water
To emergency service connection
A - Any positive clearance above top of tank
B - Sufficient elevation provide adequate pressure at point of use

THIS SCHEME eliminates chance of siphoning private supply

Watch out for health hazard in cross-connection

You might get by indefinitely with an emergency water supply cross-connection as shown in POWER, March, p 118 (sketch, above left). But any public-health engineer who inspects the plant will condemn the connection.

Health-department officials generally will not trust any physical connection between a city-water supply and a private industrial system—no matter how it's valved. City-system pressure may normally be higher than pressure in the private supply. However, a heavy draft on the mains, such as a fire-department pumper, might draw city-water pressure substantially lower than private-supply pressure for an extended period. This has occurred many times, and contamination from private supplies has caused enough epidemics to make "cross-connection" a scare word in public-health circles.

Sketch, above right, shows how you can use city supply for emergency service without any possibility of siphoning the private supply into the city system. It is somewhat more costly than a direct cross-connection, but it eliminates a serious hazard.

K M HOLADAY, *Webster Groves, Mo.*

Which bearing is better?

I'm sold on lubricated-for-life ball bearings in plant motors—especially in spots that are tough for an oiler to reach. But the chief claims that for across-the-board use there's much merit in being able to lubricate bearing when and if needed.

Right now we're trying to standardize on one or the other, where there's a choice. Has any reader had experience that would throw light on this?

J E SINTER, *Kansas City, Mo.*

Don't . . . DON'T blow oil with oxygen!

Never blow lines containing oil (hydrocarbon) with oxygen as Marmy did in *Beer can science*, May, p 154. This was actually done by Lizardo M Martinez of Jamaica, N. Y. recently. Why the tank of fuel oil didn't blow up is hard to say, but Martinez insists that he did use oxygen.

We suggest using CO_2 (carbon dioxide). The hundreds of letters and phone calls about this danger show that you readers are really on the ball. *Editor.*

Let's not have too many operators

While the arguments about having at least two men per boiler room, POWER, January, p 144, are fine, let's not have too many men in the plant.

I went to work in a new power plant designed for two-man operation. It was a one-turbine, one-boiler setup. By two-man operation, I mean the men on shift or operating crew, and not the coal handlers, janitor, etc. Total plant personnel, including the chief and office blonde numbered seventeen.

The boiler manufacturer, turbine engineer and even I complained bitterly that the plant could not be adequately and safely operated by two men. All our arguing did no good. It was started and run with an operator and an assistant operator.

Four years later if we could have put another man on a shift we would not have done it. I agree that when there is trouble two men aren't enough, but you seldom have trouble any more.

When the boiler and turbine controls are properly designed and located, there is no reason why two men can't take care of a complete power plant.

K M WHITE, *Chamois, Mo.*

(Advertisement)

One in a series.

How to Select a Steam Trap Big Enough for the Job

Adequate capacity safety factors are essential to operating efficiency

As promised to you in a previous Armstrong trap advertisement in this publication, here is some helpful information on steam trap safety factors.

First, the definition. A trap safety factor is simply the ratio between actual continuous discharge capacity of the trap and normal condensate load. If the load is 500 lb/hr and the trap actually will discharge at the rate of 1000 lb/hr, the safety factor is said to be 2 to 1, and so on.

Why a Safety Factor?

You are not going to get maximum heat transfer efficiency from any steam heated unit unless your traps are sized with a generous excess of capacity over the normal condensate load.

Remember that trap capacity is given in terms of *continuous* discharge of condensate at a given pressure differential. If you don't employ an adequate safety factor, you make no provision for these requirements or conditions:

1. ***Venting of gas,*** O_2 and CO_2, would be impossible if a trap should discharge a full stream of water continuously.

2. ***Peak loads*** would back up condensate in the line or unit if the trap were sized for average load.

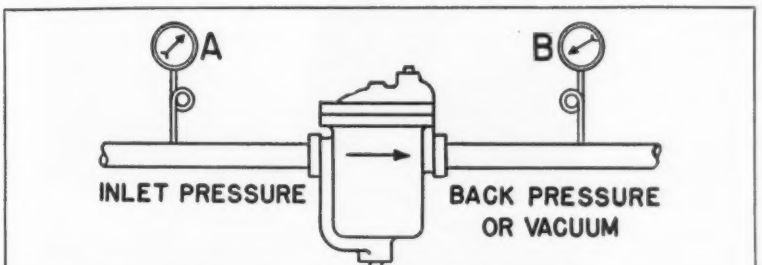
3. ***Reduction in pressure differential*** across the trap orifice would reduce capacity below requirements. If steam pressure drops below normal, trap capacity is lowered more than condensing rate. An increase in back pressure for any reason cuts trap capacity. And, pressure differentials often drop substantially during warming-up periods.

4. ***"Group" trapping.*** Very occasionally it is impractical to use an individual trap on each coil or condensing unit. Here, a generously oversized trap helps prevent backup of condensate or air from one unit to another. The frequent opening of a big trap valve "pumps" non-condensibles and condensate to the drain header.

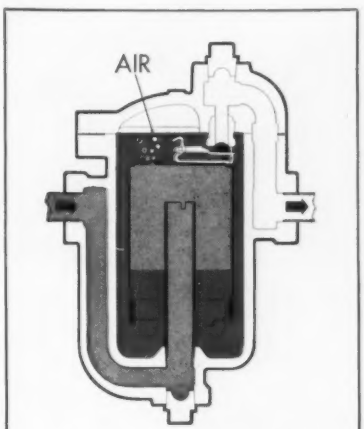
What Safety Factor?

Fortunately, it isn't necessary to calculate safety factors. Experience is the best guide and the benefit of experience with tens of thousands of successful installations is available to you. The following table is taken from the Armstrong Steam Trap Book.

Page	Equipment Drained	Safety Factors
24	Purifiers and Separators	2 or 3 to 1
25	Steam Mains or Headers	2 or 3 to 1
26	Steam Heating Pipes...	2 to 1 up to 6 to 1
29	Unit Heaters.....	3 to 1
30	Submerged Coils.....2,	3 or 4 to 1
32	Cylinder Dryers.....	4 to 1 up to 10 to 1



Pressure differential affects trap capacity. If "B" is back pressure, subtract from "A"; if "B" is vacuum, add to "A". Safety factors compensate for drops in pressure differential.



Traps vent air. This requires a trap capacity safety factor.

The page numbers listed contain completely reliable data for any trapping job.

CAUTION. The safety factors recommended in The Armstrong Steam Trap Book will have to be increased by an unknown factor for trap capacity ratings based on cold water tests, orifice tests or slide rule calculations. Armstrong trap steam temperature condensate capacity ratings are based on actual operating conditions which take into account such capacity-reducing factors as pipe friction and the choking effect of flash steam.

If you'd like to have a copy of the 44-page Steam Trap Book, just call your local Armstrong Representative, or write the factory. There is no obligation.

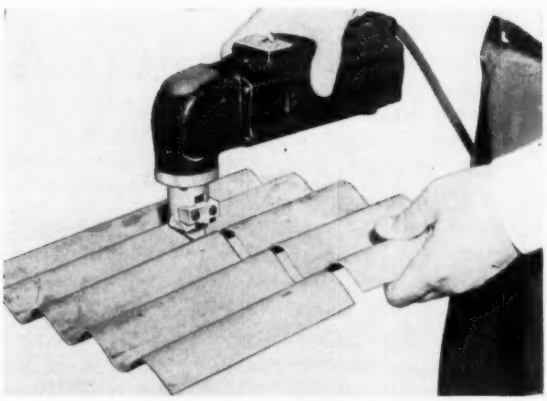
Armstrong Machine Works
8126 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

REMOVING circles or odd shapes from stainless or mild steel is duck soup for tool. Just cut a starting hole; go to work

HOW TO

Nibble through metal fast



CORRUGATED SHEETING doesn't stop this guy. Just attach unit's special parts and set nosepiece at right angle for the job

► NOW YOU CAN CUT through sheet metal up to 3/16 in. thick with this portable nibbler—and without distorting either side. Why? Because this tool is a miniature punch press. It cuts out a radius as small as 7/8 inch and, in addition, will produce a variety of odd designs. Tool, capable of speeds up to 60 in. per minute, comes in various capacities, from 8 to 13 lb, with air or electric motor.

In applications where electric tools are dangerous—oil refineries, chemical plants, etc—the air-powered model is of great value. Electric unit has a universal motor for ac or dc, 115 to 220 volts, 60 cycles.

Maintenance jobs have been slashed by as much as 75% with this handy tool. To keep it cutting at top efficiency, just sharpen punch and die by grinding a few thousandths from cutting edges. Nibbler comes in various models depending on work to be done. Every maintenance shop needs one to slash the high cost of downtime.

—*Courtesy, Fenway Machine Co, Inc, Philadelphia, Pa.*

EASY-TO-HANDLE 1-hp unit nibbles its way through 10-gage stainless steel quickly, leaving a variety of shapes behind

Send for this

Valuable guide to efficiency and economy in your boiler settings

This booklet on the famous Norton *engineered and prescribed* refractories can help you solve a good many problems affecting boiler operations.

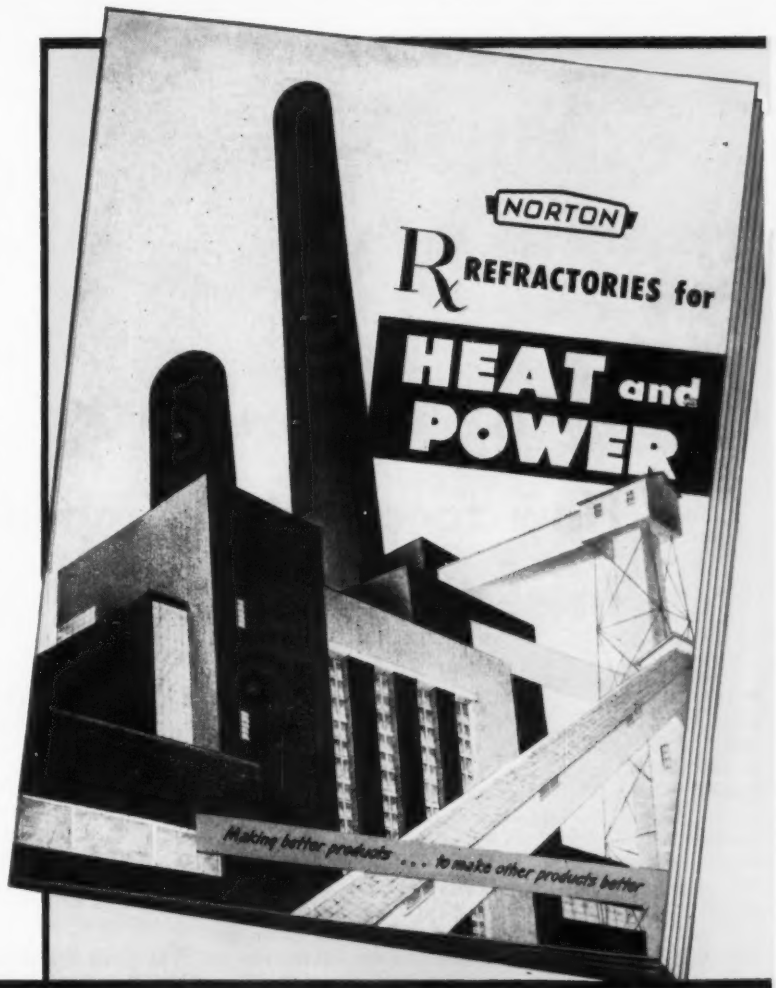
In its 32 easy-to-read pages you'll find plenty of money-saving facts, plus interesting charts, diagrams and photographs describing the many uses and advantages of Norton CRYSTOLON* refractories for heat and power applications.

Typical Rx's At Your Service

For example, this booklet gives you full information on the best protection for water tubes . . . on the construction of air-cooled and solid walls . . . on laying bricks and making general repairs . . . on the correct refractories to use for every type of boiler. In addition, the different properties of various refractories are listed, and there are handy quick-figuring charts for temperature conversion, boiler efficiency, etc.

Remember — one of the most important benefits of these refractories is that Norton *engineers and prescribes* them to help you save time and money on your own particular heat and power requirements. Find out how. Just send for this booklet and your copy will be mailed immediately. Address NORTON COMPANY, Refractories Division, 445 New Bond Street, Worcester 6, Mass. *In Canada:* A. P. Green Fire Brick Co., Ltd., Toronto 5, Ontario.

*Trade-Mark Reg. U. S. Pat. and Foreign Countries



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Making better products . . . to make your products better

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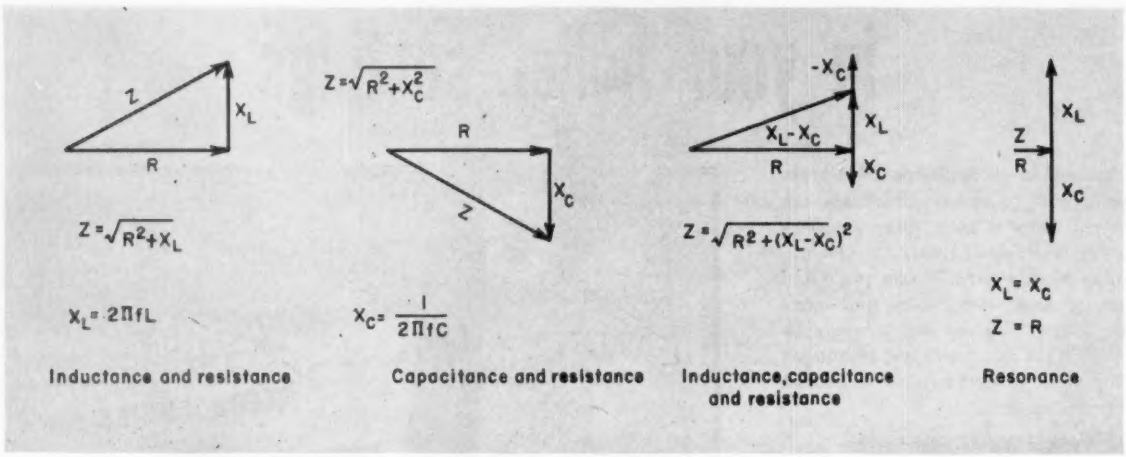
BASICS . . . *bringing engineering theory down to earth*

NORMAN PEACH, *Assistant Editor*



Electricity: II

How to calculate impedance in series ac circuits

► IMPEDANCE Z—opposition to current in ac circuits—is made up of resistance, inductive reactance, capacitive reactance or combinations of these. They can't be added by arithmetic, but in series ac circuits R, X_L and X_C can be "added geometrically." If we represent R, X_L and X_C by vectors (lines with definite direction whose length is proportional to the quantity represented), X_L and X_C will be at right angles to R and opposite to each other in direction. Why they behave this way will be taken up in a later *Basics*, as will the methods of calculating parallel circuits.

In *R—L* circuits, to find impedance square resistance and inductive reactance, add them and find the square root of the sum. Inductive reactance equals 2π (about 6.28) times the frequency times the inductance L. Inductance depends on design of the circuit (number of turns, whether magnetic flux is in iron or air, etc). Inductance is a fixed characteristic of the circuit. (Where desired, circuits can be designed with variable inductance.) Consequently, for a particular circuit, inductive reactance increases directly with frequency. Inductance is measured in *henries*.

To find inductance *L* of a circuit (such as a coil) with zero or negligible capacitance:

1. Find impedance Z by ac Ohm's law, using voltmeter and ammeter method.
2. Measure resistance R with ohmmeter, Wheatstone bridge or dc ammeter-voltmeter method.
3. Calculate X_L by formula: $X_L = \sqrt{Z^2 - R^2}$
4. Since $X_L = 2\pi fL$, at 60 cycles,

$$L = \frac{X_L}{6.28 \times 60} = \frac{X_L}{376.8} \text{ henries}$$

In *R—C* circuits, impedance is square root of sum of squares of R and X_C. Capacitive reactance X_C equals reciprocal of 2π times frequency times capacitance C. X_C will therefore decrease as the frequency increases. To find capacitance of particular circuit with negligible inductance, determine X_C by method similar to that used for X_L, then:

$$C = 2\pi f X_C = 6.28 \times 60 \times X_C = 376.8\, X_C \text{ farads}$$

The farad is a colossal unit; in power work capacitance is usually expressed in microfarads (mfd or μf), which are millionths of a farad. Using the microfarad for capacitance, X_C can be expressed as $10^6\, 2\pi f C$.

In *R—L—C* circuits, square the difference between X_L and X_C, add it to R^2, and find the square root. Since X_L and X_C are directly opposed, the reactance will be inductive or capacitive, depending on which is larger. Where X_L and X_C are equal, the reactance is zero. This condition is called *resonance*. Because X_L increases and X_C decreases as frequency goes up, there is some frequency at which any *R—L—C* is resonant. At resonance $Z = R$.

In an *L—C* circuit with negligible resistance, impedance is the arithmetic difference between inductive reactance and capacitive reactance. At resonance it's nearly zero.

Next month's Basics: What phase *means in ac circuits.*

for longer valve life

in a variety of corrosive services

JENKINS NI-RESIST GATE VALVES

Where you encounter acids, salt and alkaline solutions, sea water, brine or other corrosive fluids, vapors or gases, you'll want Jenkins Ni-Resist Type 2 Cast Iron Gate Valves with type 316 stainless steel trim. They have a remarkable ability to withstand destructive corrosion and erosion.

In paper mill service, food processing, petroleum refining, chemical plants and other process industries, Jenkins combination of Ni-Resist type 2 cast iron and type 316 stainless steel, plus Jenkins extra *value* construction throughout greatly extends valve life.

Designed especially for corrosive services, the Jenkins Ni-Resist line of gate valves also has superior metal-to-metal wearing qualities. Copper-free, they will not discolor or contaminate products being carried in the line. Let the famous Jenkins Diamond be your guide when choosing Ni-Resist valves . . . it means longer, trouble-free service.

GET COMPLETE INFORMATION

from your Jenkins Distributor, or write Jenkins Bros., 100 Park Avenue, New York 17.

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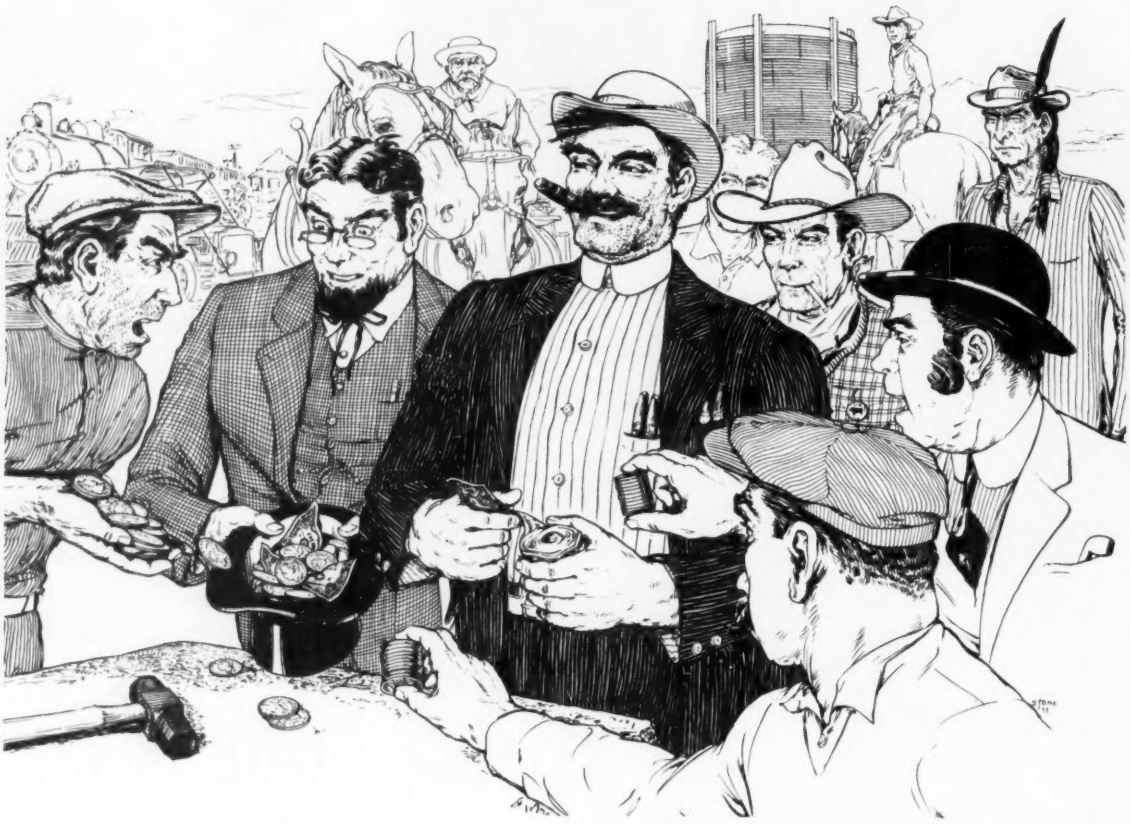


"Those native sidewalk superintendents kept shoving silver at me," roared Marmaduke Surfaceblow

Marmy gets loaded in Reno

► "A ROLLING STONE gathers no moss, but it gets a fine polish," said one of the best all-around operating engineers I ever worked with. Today's young operators can't understand the feeling of the old-timers who didn't consider themselves full-fledged operators until they'd traveled around the country, working in dozens of different plants.

Their school of hard knocks gave them a firsthand knowledge of machinery in icehouses, laundries, breweries, dairies, mills, packing houses, water works and even portable machinery on construction jobs. Many ended up aboard deep-sea ships, on the lakes or on riverboats. To be an operating engineer, you had to be ready to run almost any type of plant.

Well, we still know one old-timer who has done all these things and more. His name is Marmaduke Surfaceblow, ex-stationary and marine engineer. These days he makes a fast buck as a consulting engineer in New York City.

Climbing the rickety stairs leading to the cantankerous consultant's place of business over O'Houlihan's Machine Shop & Engine Works, I saw his door open. Sounds coming from his office reminded me of a buzz saw.

Stepping inside, I found Marmy, snoring away in his swivel chair. His canalboats were propped up on his tired old roll-top desk. The foxy gent was sawing wood, and no mistake about it.

His settee was held down by the usual waterfront characters slurping coffee, smoking, chewing snuff and arguing at the top of their lungs.

"The *SS Tuscarora* had eleven decks and a straw bottom," guffawed a tough-looking mariner with cauliflower ears.

"Yea," chimed in a lanky character in a ship officer's high-pressure cap, "and her boilers had bamboo tubes."

"You guys remember what happened to her?" rasped a tough-looking mariner with tattoos covering his hairy arms. "The sea cows her black gang kept in the shaft alley ate out her straw bottom on the last voyage. Har, har, har."

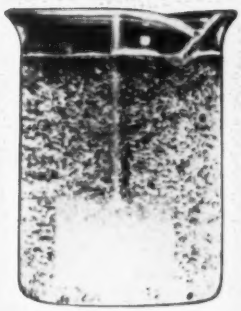
Marmaduke suddenly came to life, opened his steel-gray eyes, yawned, then roared in his foghorn voice, "BILGEWATER on the *Tuscarora*. I'll tell you sea clowns about the time I made some easy money in Reno. And all I did was use feathers instead of sledge hammers to break up concrete." Then he sat up, lit a piece of rope yarn, and blasted away.

"Back in 1915, I was sailing up and down the West Coast aboard a lumber schooner," he bellowed after another terrific yawn. "We ran into a big blow outside the Golden Gate one night and limped into dry dock with our battered ship on her beam-ends. While ashore in San Francisco next day, I ran into a hard-drinking two-fisted construction man at the Mermaid Inn on the Embarcadero. We got to be buddies when he found I could outdrink him, and he offered me (*Continued on page* 220)

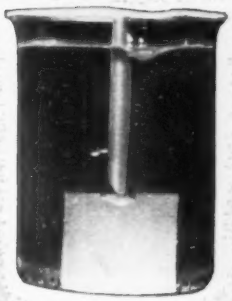
A New, Better Coagulant

NALCO 600

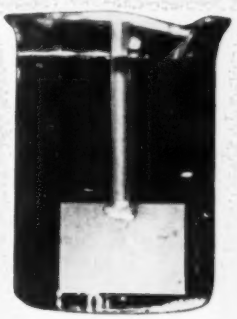
POLYELECTROLYTE



Alum



Alum plus typical polyelectrolyte



Alum plus Nalco 600

As a coagulant in water clarification, and under many process coagulation conditions, new and different Nalco 600 has shown such great promise, both in performance and economy characteristics, that it has now been made available for general use as an established member of the Nalco family of chemical aids to industry.

Extremely difficult coagulation conditions provide especially economical applications for Nalco 600. It can be used alone or in conjunction with other coagulants. A very low dosage of Nalco 600 usually permits as much as 50% reduction in dosage of alum, activated silica, iron sulfate or clay type treatments . . . and results in a cleaner, clearer supernatant liquid.

Nalco 600 was invented in the Nalco Laboratories, and is being manufactured *only* by Nalco. For complete data on Nalco 600, and expert technical assistance to solve your clarification and coagulation problems, call Nalco now.

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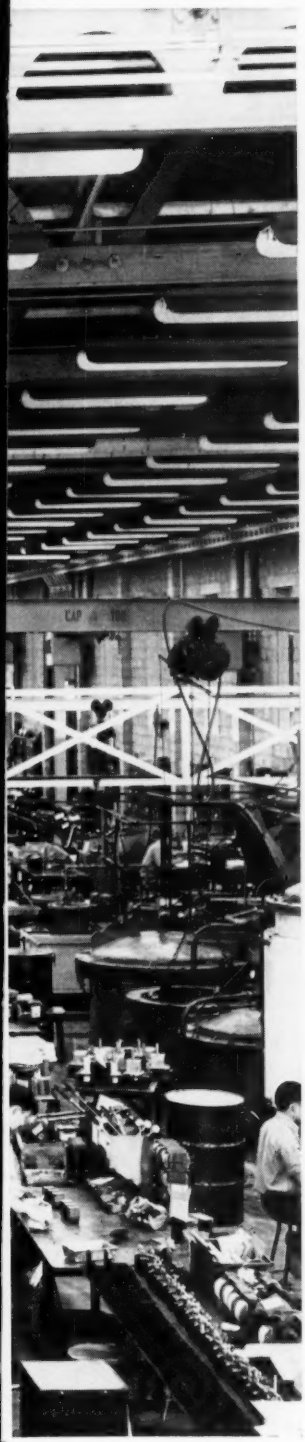


Here's how Westinghouse power centers increase plant output...safely

Safe, efficient power distribution that actually helps increase plant output... that's what this Western Pennsylvania manufacturer realized by installing modern Westinghouse dry-type power centers.

Dry-type power centers minimize installation costs because they are completely safe. Since they are *both* fire and explosion resistant, they can be located right in the production area. They require no vaults, catch basins, toxic gas vents, or drains. Lightweight, they can be installed overhead, releasing valuable floor space for production. This makes it easier to locate them close to the load they serve, shortening secondaries, cutting line losses, improving regulation. The result: Increased production efficiency.

In the plant pictured at the left, two Westinghouse power centers divide the load. Capacity is provided in each to allow for expansion.

Add these up for your plant: (1) Safe, economical installations. (2) Increased production space. (3) Increased plant efficiency through improved regulation. (4) Savings in power cost through reduced losses. (5) Savings in heavy copper through shortened secondaries.

Westinghouse power centers can bring these advantages to your plant, too. Because they are factory assembled and coordinated as one unit, with components designed to meet your individual requirements, they can be installed quickly and easily. For further information, check with your contractor, your Westinghouse distributor or local representative, or write direct to Westinghouse Electric Corp., P.O. Box 868, Pittsburgh 30, Pa.

J-70708

YOU CAN BE SURE...IF IT'S Westinghouse

Reader service section

Start with these quick samples...

Atoms for industry . . .

that's the story that takes the lead on this month's news page. What plans are afoot among the nations of the world in regard to industrial use of nuclear power? How does U.S. progress along these lines compare with that of Britain or the other nations of Europe? What philosophy guides U.S. policy on reactor building?

Reports from the field, p 154

Problems, problems, problems . . .

that constant cry of the practicing engineer finds an answer here. Every month *Power* prints a digest of technical papers written by some of the best brains in the business. This month's collection covers such subjects as steam generation, heat transfer, electricity and gas turbines, leading off with *New problems in auxiliary system design.*

Technical briefs, p 156

Plastic-covered transformers . . .

are the newest brainstorm at General Electric. And if all goes according to GE's blueprints, these units will be available for your plant in the near future. Story on this project appears on the lead page. Subsequent pages provide photos and information on meters, valves and safety equipment for nuclear applications. Before you buy, check . . .

Plant equipment news, p 160

The literary set . . .

swears by *Power's* listing of free manufacturers' bulletins. There's nothing like it, they insist, for a handy guide to the latest on the newest equipment. Thirty-some-odd catalogs, handsomely jacketed and filled with specs, are available simply for the price of a stamp. You're free to choose one or all from . . .

Free literature, p 169

A gem of a year . . .

This year marks *Power's* diamond anniversary. And plans for the birthday issue in September have our editors on the go. The crowd at the water cooler has disappeared and typewriters beg for mercy as we work to make our deadline. But in the midst of the frenzy there's one guy, always calm, who has time to tell you all about the issue . . .

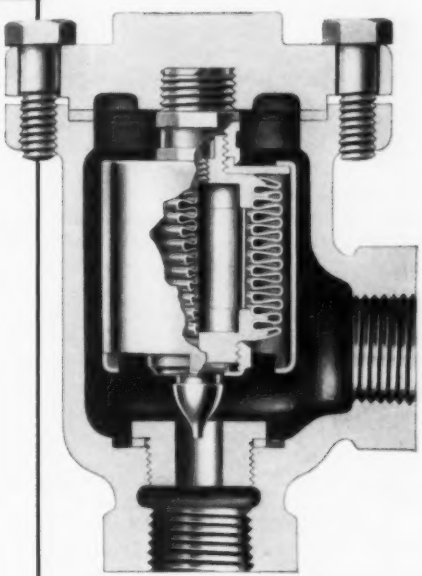
George Edwards, p 172

For other timely ideas, see following service pages▶

Proven by performance!

All departments agree on operating efficiency of SARCO Thermostatic Steam Trap

	MAINTENANCE	PURCHASING	STORES
1. **Same head and seat for 0-300 psi** — no changing of heads and seats for varying loads and pressures.	✓	✓	✓
2. **Fewer parts to stock** — same bellows, head and seat for 0-300 psi.		✓	✓
3. **Greatest capacity per dollar cost** — 1" size discharges 9,650 lbs/hr at 10°F below steam temperature, 125 psi.		✓	
4. **Very compact and light** — ¾" size fits in palm of the hand. Weighs only 3¾ lbs.	✓		
5. **Freeze-proof**—wide open, self-draining when cold.	✓		
6. **Only one working part** — the thermostatic element. Can be inspected or replaced in few minutes without moving trap from line.	✓		



SARCO

Balanced Pressure

THERMOSTATIC STEAM TRAP

Same seat and head
for all pressures to 300 psi

•

Sizes ½" to 2"

•

Write for Bulletin 250

Proven by testing!

Steam-tested — every single Sarco Thermostatic is steam-tested at rated maximum pressure.

Proven "on-the-job" performance — maximum fatigue-resistance for every thermostatic element is assured by Sarco's exclusive helical corrugating process and fatigue testing method.

Quality Control — every step of manufacture under exacting tests and controls . . . in Sarco's own plant.

Proven by experience!

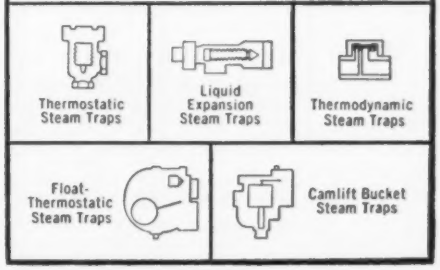
During past 40 years, over 1,000,000 Sarco Thermostatics have been installed in countries throughout the world!

Sarco Company, Inc., Empire State Bldg., New York City

AN AFFILIATE OF SARCOTHERM CONTROLS, INC.

Only Sarco Makes All 5 Types

. . . that's why Sarco can give impartial advice on trap selection



2212-B

STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES

REPORTS FROM THE FIELD

What's happening in power and what it means to you

For Calendar of Events see page 238

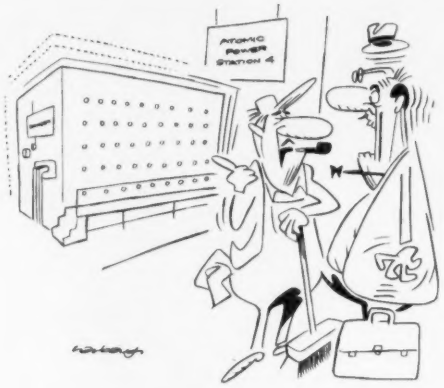
Roundup: Atoms for industrial power

The man with the broom, cartoon right, obviously is not in the know about atomic energy. His ignorance, though funny, is perhaps symptomatic of a deeper ignorance on the part of the public. The average citizen still thinks of atomic energy in terms of death and destruction, remaining unaware of the solid progress the world is making towards peaceful use of atoms for power. Here, in the U.S., we have four full-scale atomic energy plants, with a total capacity of 520,000 kw, under construction. Fifteen others are in various stages of planning ranging from pure intention to actual design.

To Great Britain, the development of nuclear power means its survival as a major power. Britain's nineteenth century economic leadership was based on coal and seapower. In seapower, Britain has been outdistanced by the U.S. and is running neck and neck with Germany and Japan. Coal, still the main fuel source and apt to remain so, must supply the power needs of an increasingly large number of industries. It is practically the only natural resource Britain has and if it is to last must be supplemented.

The Suez crisis demonstrated that oil supply is no longer dependable. Nuclear power holds the answer. And the British have wasted no time in seeking it. Calder Hall, the world's first nuclear power station, opened last October. It is the first such station in a proposed series of 20. When the last station opens Britain will have the most extensive nuclear system in the world. By 1965, the British expect that 1/6 of the nation's electricity will come from this source.

This year, six other European nations set their sights on a nuclearpowered future. Encouraged by Britain's success and spurred on by the same fuel problems, West Germany, Italy, France, the Netherlands, Belgium and Luxembourg drew up and signed, on March 25, the Euratom Treaty. This treaty provides for an effective common market in most nuclear industry goods and possibly for the purchase of common reactors. The six nations will cut tariffs and quotas among one another and erect their common external tariff against the outside world. It is hoped that the treaty will be ratified by early fall or perhaps even this month. Three to six weeks after ratification, orders for main power program will be placed. Euratom (*Continued on page* 238)



"It took me an hour last night to shove all those poles back in the holes . . ."

Power Lines

U.S. Maritime Administration has awarded a contract for design of the first atomic-powered surface ship to George G Sharp, Inc, New York marine design firm, and Walter Kidde Nuclear Laboratories, Inc, Garden City, N. Y., atomic industrial designers and consultants. Preliminary work is to start immediately. Vessel's power plant will resemble that of *Nautilus.*

Sweden lays claim to the world's largest generator with the installation of a 2500-mva unit in the high-power test laboratory at Ludvika. Units, installed for Swedish ASEA company, necessitated larger lab. Will be used for tests of 3500 mva at voltages to 13 kv.

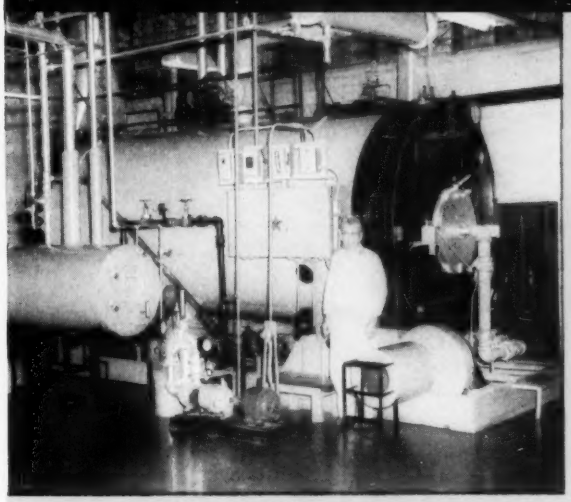
Bogota, (McGraw-Hill World News)—Near Bogota, Colombia will install its first atomic reactor toward the end of 1957 or early in 1958, according to the Minister of Mines and Petroleum, Dr F Puyana.

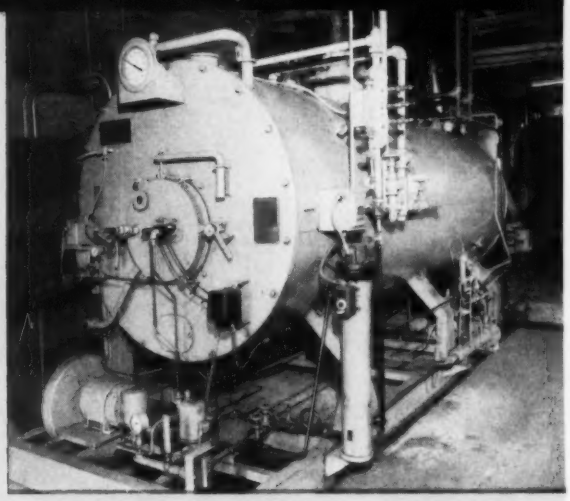
Contract for one of the largest coal handling systems ever installed as initial equipment has been awarded Link-Belt Co. Thomas H Allen Electric Generating Station of the Memphis Light, Gas & Water Div, City of Memphis, gets the system which has an initial coal handling capacity of 2200 tons an hour.

World's first solar energy center, to conduct experiments in the use of the sun's power, will be built at Tierra del Sol, Calif, according to J Y Leveque, sponsor of the project. Initial construction is slated to get under way in the next few weeks.

Another boost to engineering and scientific research is announced by Engineering Foundation, whose endowment fund has recently been increased by 100 shares of General Motors stock, gift of Professor Orlan W Boston. Stock will be invested and income used.

Some Typical Steam Problems Solved by AMESTEAM GENERATOR



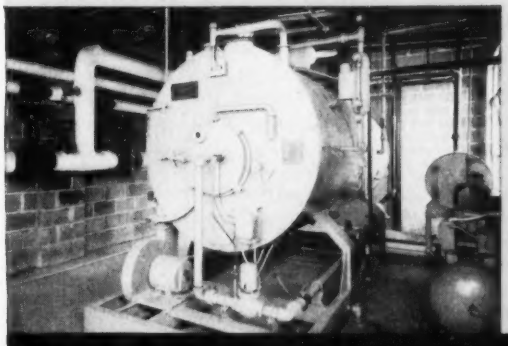


"...EXTREMELY VARIABLE STEAM DEMAND HANDLED SMOOTHLY AND EFFICIENTLY" at St. Joseph Paper Company, Houston, Texas. Writes C. J. Christman, Plant Engineer:

"We have an AMESTEAM GENERATOR, 300 HP, 150# W. P. in our plant. It has been in operation since January, 1949. We have an extremely variable steam demand, but this boiler handles it smoothly and efficiently. Practically all the original equipment is still in use and in first-class operating condition. We have never had a leak in our boiler or pipe installation during seven and one-half years of uninterrupted service. The boiler is economical, maintenance costs are very low, and we are completely satisfied."

"...BEST DOLLAR INVESTMENT WE HAVE MADE TO DATE," reports Scranton Wiping Cloth Company.

"...of all the equipment we purchased last year to completely equip our new laundry facilities, which include your 150 HP heavy oil, high pressure automatic AMESTEAM boiler," writes company official L. Light, "we can honestly state that the performance of this piece of equipment has been such that we now consider it the best dollar investment that we have made to date. From a fuel standpoint alone, our records indicate that it is costing us 51.7c per thousand pounds of steam..." (not counting the maintenance labor savings enjoyed by this firm!).



"VERY SATISFACTORY" on lumber dry kilns is the report by J. S. Gudmundsson, Director, Foreign Trade Division of Wood-Mosaic Corporation, describing performance of the AMESTEAM GENERATOR at the firm's New Orleans yard.

"The AMESTEAM GENERATOR we have there for running our lumber dry kilns has operated very satisfactorily, and we would specifically like to comment on the very excellent service that your representative has given us."

WHAT'S YOUR STEAM PROBLEM?

If you need 10 to 600 HP and want the kind of space-saving, trouble-free service enjoyed by these owners of AMESteam Generators, write today for our catalog and the name of your nearby Amesteam dealer.

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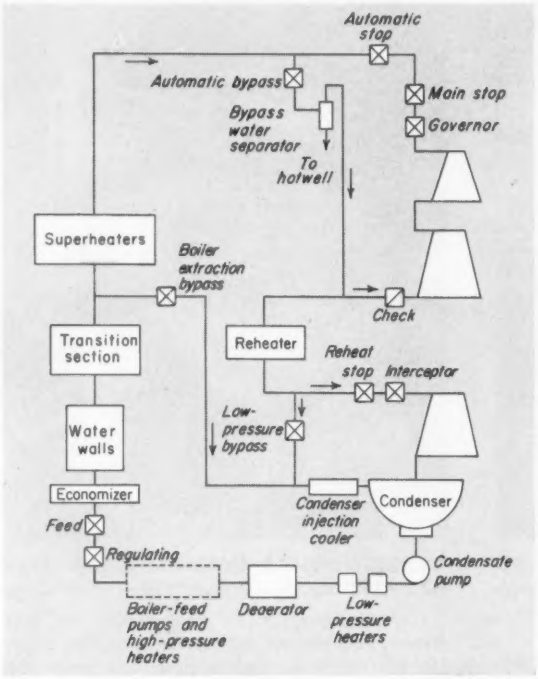
TECHNICAL BRIEFS

Latest engineering developments for busy power men

23 papers for you on
STEAM GENERATION
HEAT TRANSFER
ELECTRICITY
GAS TURBINES



SUPERCRITICAL pressure single-reheat cycle. Absence of steam drum makes continuous operation of the boiler-feed pump vital

New problems in auxiliary systems

New problems in auxiliary system design—supercritical pressure and nuclear plants. *By A R Jones and C J Baldwin Jr, Westinghouse Electric Corp.*

Two newest developments in power generation—supercritical pressure cycles and nuclear reactors—are imposing additional requirements on powerhouse auxiliary systems. The conventional system of the past must be modified to accommodate larger total loads, larger single loads and more stringent service continuity requirements. New auxiliary system layouts must be made with full recognition of heat cycle peculiarities and new operating procedures.

Boiler-feed-pump power supply and bus transfer requirements are the areas of interest receiving special discussion in supercritical pressure plant design. For a nuclear plant, main coolant-pump power supply and continuity of service to other vital loads deserve attention.

This paper discusses the plant heat cycles from the auxiliary system viewpoint, outlines the auxiliary system requirements, gives typical solutions used by plants in the design and construction stages. *AIEE paper No. 57-51.*

Forced outage rates of high-pressure steam turbines and boilers. *By AIEE Joint Subcommittee on Application of Probability Methods to Power System Problems.*

This report is a presentation of the final results of a 5-yr nationwide outage survey of horizontal steam turbine-generators operating at pressures of 700 psi or greater and rated at or over 20,000 kw condensing or 10,000 kw superposed, and of boilers with continuous rated capacity of 200,000 lb per hr or more and with outlet pressures of 700 psi or greater.

The objective of the study was to obtain forced outage rates of the equipment for use in applying probability methods to power system problems involving such facilities.

A summary of results shows the forced outage rate for turbines over the 5-yr period, as follows: pressures less than 1000 psi, 0.78%; 1000 to 1350 psi, 1.10%; above 1350 psi, 0.89%. For boilers, the average figures for the 5-yr period are: pressures less than 1000 psi, 0.84%; 1000 to 1350 psi, 1.33%; over 1350 psi, 0.90%. *AIEE paper No. 57-145.*

In-service washing of Ljungstrom air preheaters on pulverized coal-fired steam generators. *By H J Hupfer, R J Stanley and A H Van Sickle, The Detroit Edison Company.*

The St. Clair power plant of the Detroit Edison Company has experienced difficulty with air-preheater fouling caused by flue-dust deposits on the cold-end surface. Removal of these deposits by the conventional out-of-service washing technique has not been satisfactory, pointing up the need for effective in-service washing.

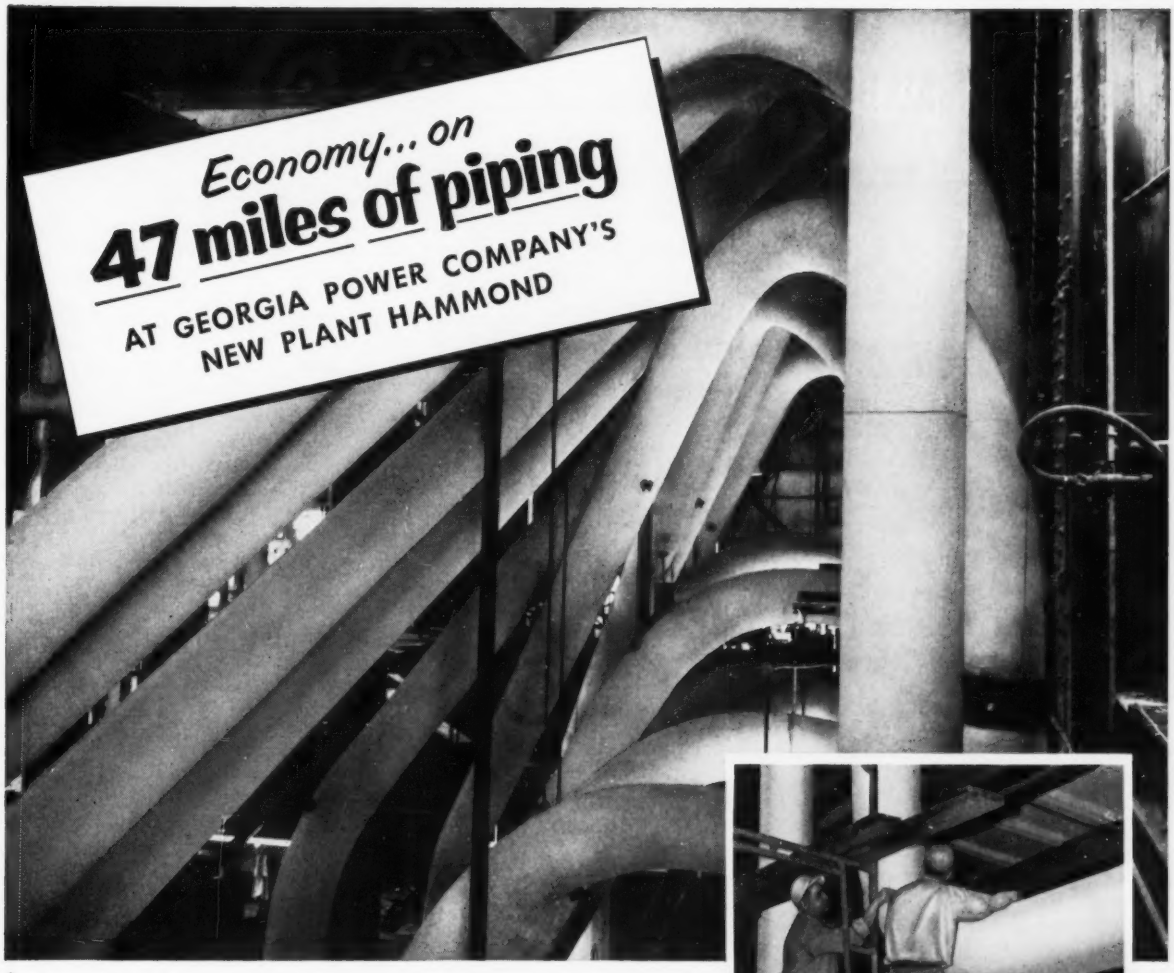
This paper discusses the equipment and methods used and the results obtained from eleven in-service washings. The known factors responsible for success or failure are discussed.

Authors' opinions are that in-service washing is practical. It provides a means for increased unit availability and improved boiler economy. As a result of the program, the average cold-end temperature of one St. Clair unit has been lowered from 200 to 180 F on a trial basis. *ASME paper No. 56-A-161.*

CO boiler pays off in fuel savings and produces zero CO. *By N E Pennels, Sinclair Refining Co.*

The CO boiler was developed to effect substantial fuel savings through the combustion of the carbon monoxide content of catalytic cracking unit regenerator flue gases. The boiler can burn the regenerator flue gas to zero carbon monoxide. This will make it an effective air-pollution control device in areas where local conditions require limitations on emission of carbon monoxide to the atmosphere. *ASME paper No. 56-A-198.*

More Technical Briefs on page 158



47 miles of Johns-Manville 85% Magnesia Insulation boosts operating efficiency of Plant Hammond, one of the South's largest and most modern private utility installations.

Insulating feed water line at Plant Hammond. Contractor for this job was Brooks-Fisher Insulating Company of Atlanta, Georgia.

J-M 85% Magnesia Insulation helps cut fuel rate 25% below national average

Officials of the Georgia Power Company were gratified when the coal rate of their new Plant Hammond worked out at 0.75 lb. per KW HR, 25% below the national average. In their annual *Electrical Industry Statistics, Electrical World* had reported that increased efficiency in the techniques of power production has lowered the average coal rate to 1 lb. per KW HR. in 1954.

An important factor contributing to Plant Hammond's high efficiency was the selection of insulation. Johns-Manville's 85% Magnesia was applied in the most economical thicknesses throughout the plant for all piping and equipment operating in its temperature range. At higher temperatures 85% Magnesia was used in combination with J-M Superex® diatomaceous silica insulation.

This is only one of thousands of case histories where J-M 85% Magnesia has helped industry achieve outstanding fuel savings and increased operating efficiency. In all types of manufacturing and processing plants it is the standard for temperatures to 600F . . . providing high insulating value, easy application, long life, initial low cost and minimum maintenance. Write today for further information on J-M 85% Magnesia and Johns-Manville's complete drawing-board-to-job-site insulation service. Address Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

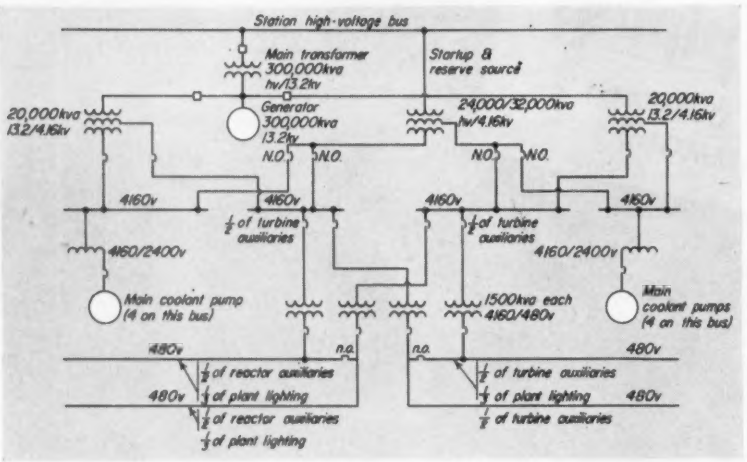
JM PRODUCTS

Johns-Manville *first-in* INSULATION

MATERIALS · ENGINEERING · APPLICATION

More TECHNICAL BRIEFS

Begins on page 156



STATION AUXILIARY electrical diagram for 200-mw nuclear plant. The reactor coolant pumps and other vital loads require extraordinary continuity of service

Heat transfer

The effect of condensate reheat on mean temperature difference in feedwater heater subcooling zones. *By K A Gardner, The Griscom-Russell Co.*

Considerable error in heat-transfer surface calculations for the condensate subcooling zones of combination feedwater heaters may be introduced by ignoring heat leakage into the zone from ambient fluid. Certain subcooling approaches cannot possibly be met, regardless of the suface extent. In other cases, the use of the effective mean-temperature differences presented in this paper will insure meeting desired approaches that could not be met if surface were chosen on basis of logarithmic mean-temperature difference.

In spite of the fact that a portion of the condensing zone duty is performed by heat leakage through the subcooling zone envelope, which may have a drastic effect on required subcooling surface, the condensing surface requirement is affected only negligibly.

Equations are presented for determining the mean-temperature difference, feedwater and condensate-outlet temperatures and minimum subcooling terminal approach. These are given in terms of the relative heat-transfer capability of the zone envelope as compared to the tube surface enclosed. *ASME paper No. 56-A-69.*

Rate of temperature change of simple shapes. *By V Paschkis and J W Hlinka, Columbia University.*

Charts have been prepared showing rates of temperature change in simple shapes plotted against temperature. Additional curves show time values, so that one graph yields any of the three relationships: rate-temperature, rate-time, temperature-time. Samples of the charts are shown, examples of use are given and limits of the graphs are tabulated. Methods used in establishing the charts are given. *ASME paper No. 56-A-118.*

Compilation of radiation shape factors for cylindrical assemblies. *By H Leuenberger and R A Person, Union Carbide & Carbon Corp.*

Design and evaluation of cylindrical furnaces, kilns, reactors and other devices in which radiant heat transfer is important requires knowledge of shape factors to assess the energy transfer by radiation. Analytical expressions for the shape factors of various cylindrical assemblies, some previously unavailable, have been obtained and tabulated. *ASME paper No. 56-A-144.*

Estimation of temperature patterns in multiply-shielded systems. *By J G Bartas, General Electric Co, and E Mayer, ARDE Associates.*

Method of difference equations is applied to the problem of estimating temperature patterns in multiply-shielded systems. Results are obtained in terms of elementary functions which can be readily evaluated. The equations are employed to examine the effect of shield curvature, end radiation and gas radiation on the temperature recorded by a shielded thermocouple for a variety of operating conditions. Calculations indicate that whereas shield curvature and gas radiation may be neglected in a well-designed shielded thermocouple, end radiation can result in a substantial error in the thermocouple - temperature measurement. *ASME paper No. 56-A-130.*

Transient air temperatures in a duct. *By S E Rea, Boeing Airplane Co, and C M Ablow, Stanford Research Institute.*

Transient temperatures in a thin-walled duct carrying heated air are investigated experimentally and theoretically. The simplified theory applies to turbulent liquid or low-speed gas flow. The duct wall is shown to be an important heat reservoir. *ASME paper No. 56-A-70.*

Electricity

Electrical features of Eastlake generating station units 1, 2 and 3. *By C F Paulus, The Cleveland Electric Illuminating Company.*

The new Eastlake plant is designed for an ultimate capacity of upwards of 1,000,000 kw. The four units at Eastlake raise total installed capability of the Illuminating system to some 1,800,000 kw.

The author describes the main connections, transmission circuits, metering of main circuits, protective relaying, station service supply, normal and emergency transferring, power and lighting centers, station service circuits, control boards, etc. *AIEE paper No. 57-179.*

Locating surge arresters and capacitors for rotating machine protection on industrial power systems. *By A H Knable and D Dalasta, Allis-Chalmers Mfg Co.*

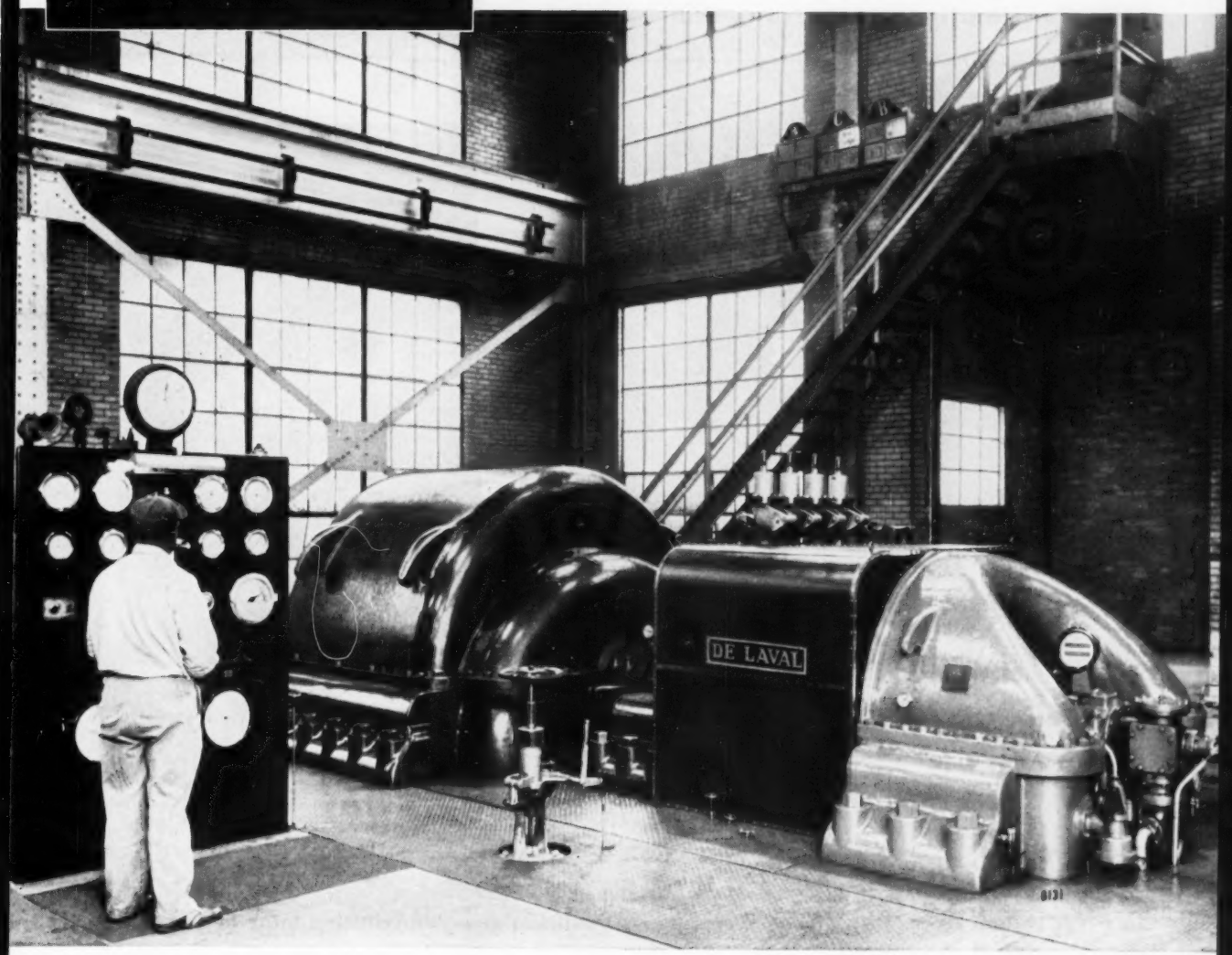
There are several ways that transient voltages can occur to overstress rotating machine insulating systems. The two most common origins of these overvoltages are lightning and switching surges. This paper considers only stresses caused by lightning.

Conclusions reached include the following: (1) The presence of feeder cables at the distribution bus tends to reduce stress on machine insulation. But the number of feeder cables required to make a system self-protecting (without surge capacitors) is greater than that usually present in industrial power systems. (2) For the same voltage class, machines with a long winding turn length require more capaci-

(*Continued on page* 252)

DE LAVAL
BLAST FURNACE BLOWERS

give 20 years of service at Great Lakes Steel Corp.



Shown is one of two De Laval centrifugal blast furnace blowers at the Ecorse, Michigan, plant of the Great Lakes Steel Corporation, Division of National Steel Corporation. This 85,000 cfm unit was installed twenty years ago; another 75,000 cfm unit went on the line a year earlier. Both have given dependable round-the-clock service ever since. These turbine-driven blowers are hooked up to a multi-head which enables either one to be used in conjunction with any of the three blast furnaces.

De Laval centrifugal blowers are built in single and multi-stage types to supply air in volumes up to 150,000 cfm for all classes of service in steel, gas and coke plants. The wealth of application experience acquired by De Laval over the years assures a correct and economical solution to your blower problem.

Send for Bulletin 0504

DE LAVAL *Centrifugal Blowers*

DE LAVAL STEAM TURBINE COMPANY
815 Nottingham Way, Trenton 2, New Jersey

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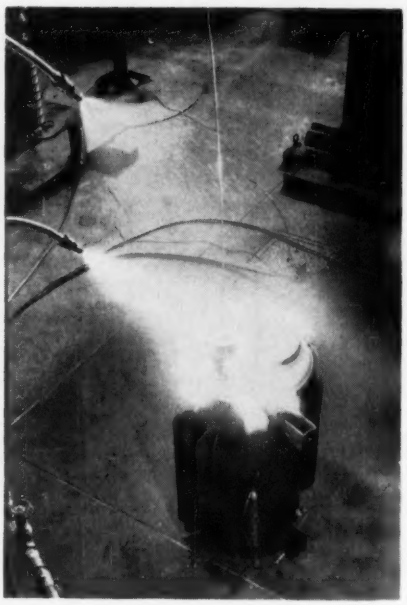
PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers



Plastic-covered transformers undergo severe water and wear tests

601 • These experimental units, first step toward the transformer of the future, have plastic covers and bushings molded together in one piece.

Not yet for sale, 100 pole-type transformers with the new covers and bushings will be given extensive field tests.

Manufacturer claims that this new development promises longer life, reduced maintenance and increased overall economy despite the present cost advantage for conventional steel covers and porcelain bushings.

Manufacturer sees these advantages for utilities in molded plastic covers and bushings: cover will need no painting; plastic bushing is not brittle—has good resistance to chipping and mechanical damage. Squirrels can't cause outage.

General Electric Co, Schenectady 5, N. Y.

Dry-type transformers with dust-free sealing

602 • Group of transformers meets the need for a single series of transformers for a wide range of outdoor as well as indoor installations, according to manufacturer. Covers ratings of 5 kva, 7½ kva and 10 kva, single-phase 60-cycle; 9- and 15-kva 3-phase 60-cycle in all standard voltages of 600 and below. Size and weight per kva have been reduced, manufacturer claims. External case has normal temperature rise of only 40 C.

Dust-free sealing is said to have eliminated the need for cleaning coils which is a must requirement on open or ventilated type air-cooled transformers, according to manufacturer. Units can be mounted with three bolts to beams, columns or walls. Large wiring compartment and knockouts on sides, back and bottom together with solderless, clamp type connectors on a rigid insulating board are said to make connecting easy. Nameplate lists connection diagrams. Request complete details direct from the manufacturer.

Acme Electric Corp, 40 Water St, Cuba, New York

Tradition gets go-by in dc motor design

603 • Line of direct-current industrial motors and generators are designed to operate as basic power movers or as elements of automatic production systems.

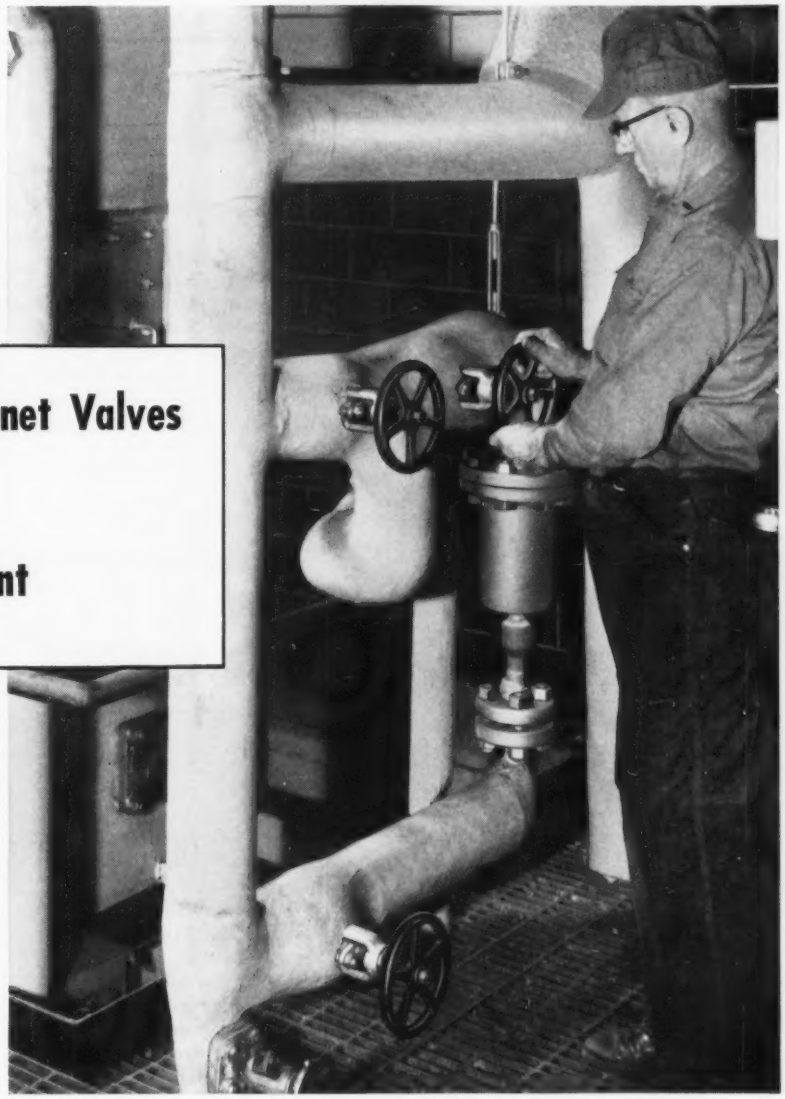
Units are designed with dripproof enclosures as standard, bear NEMA Class B ratings; they span motor ratings from 1 to 150 hp and generator ratings from ¾ to 100 kw.

Features available include a high-temperature silicone insulation system in machines rated to operate within Class B temperatures; a controlled ventilation system that draws air from the drive end, distributes flow positively through the machine and expels it at commutator end; and a housing construction which enables the dripproof machines to serve many applications which ordinarily require splashproof equipment. Armature inertia of entire line has been decreased —by as much as 55% in some ratings—and commutating ability increased by 35%, according to manufacturer. Request additional details from manufacturer.

Westinghouse Electric Corp, Box 2278, Pittsburgh 30, Pa.

For more data on these items, use post cards on page 169. Identify your request with item number

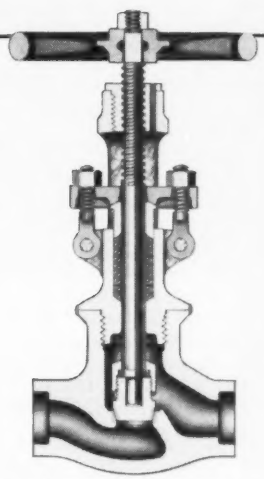
Newest Design in Small Steel Globe, Angle and Check Valves



Crane Lip Seal Bonnet Valves
(patented)

Save Money

for This Power Plant



Central Illinois Electric & Gas Co.'s experience with Lip-Seal valves is typical. Since 1952, this patented Crane small steel valve design for high-pressure/high-temperature service has saved this utility many dollars.

Shown is a 3-valve installation at Sabrooke Station in Rockford on 900 psi steam lines to the ash removal system. In more than 5 years on this tough service, none was given more than minimum routine maintenance—never any attention to bonnet joints.

On other severe services as well, the plant is aware of the continuous good performance and easy care of Lip-Seal valves. More are being installed as other makes give out.

Lip-Seal design features a strong, non-freezing screwed bonnet joint that holds pressure load, with a peripheral weld for tightness only. Weld grinds off easily and repeatedly without damaging joint.

Improved disc-stem connection minimizes vibration . . . provides pilot guiding for the disc. Stellite seating surfaces withstand temperature, corrosion and erosion. Globe, angle and check patterns; 1500- and 2500-pound classes. Sizes ½ to 2 inches. Get full information from your Crane Representative.

Literature on Lip-Seal valves supplied by your Crane Man, or write to address below.

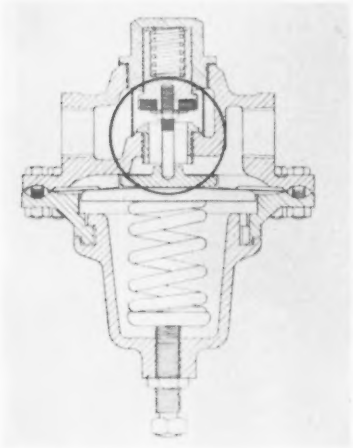
CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill., Branches and Wholesalers Serving All Areas

More EQUIPMENT NEWS

Begins on page 160



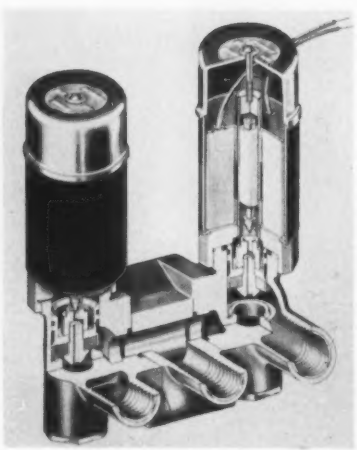
High-capacity regulator

604 • Regulating valve incorporates a larger through passage which gives a greater capacity and also a less turbulent flow pattern through the valve, states the manufacturer.

Valve discs are interchangeable, allowing the user to switch from water service, for example, to steam, gas or air. User removes one disc and substitutes a disc for the service he desires. It is said that the fact that spring adjustment is made from below rather than from above is a safety factor.

Reduced pressure range is from 1 to 100 psi, depending on valve size.

Davis Regulator Co
2540 S Washtenaw, Chicago 8, Ill.



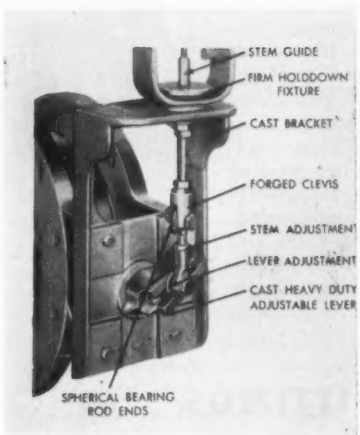
Duplex solenoid valve

605 • Three-way valve is said to provide unusual flexibility for three-way flow applications. Unit is available in three assemblies for mixing, divided flow and cylinder control operations.

Unit is bubble tight and may be used at specific pressures ranging from 5 to 1000 psi with both pistons normally closed and at 5 to 500 psi with either or both pistons normally open. It is available in ½ and ¾-in. pipe sizes.

Unit may be used on air, water, oil or any fluid not harmful to Navy M bronze. On liquids, controlled closing can be built in to prevent shock.

Atkomatic Valve Co, Inc
545 W Abbott St, Indianapolis 25, Ind.



Valve bracket and linkage

606 • Standard bracket and linkage arrangement for butterfly valves is said to simplify their hook-up with automatic control operators. Arrangement also is said to reduce power requirements in close control applications.

Rod end bearings allow for lateral movement of the linkage, necessary in changing from straight line to rotary motion. They fit tight with their companion pieces. Therefore, says manufacturer, an almost friction-free connection is provided between the operator stem and the valve shaft.

W S Rockwell Co
200 Eliot St, Fairfield, Conn.

Spring-loaded valve

609 • Relief and back pressure valve is designed to function on both condensing and non-condensing systems.

In condensing systems, this valve is used to maintain constant back pressures in the exhaust line from an auxiliary engine or turbine. On the condenser of any auxiliary equipment, it functions as a relief valve if the vacuum is lost. In non-condensing systems, the valve serves as a back pressure control valve.

Atlas Valve Co
280 South St, Newark 5, N. J.

Branch outlet connections

608 • These fittings were designed to function as a universal outlet connection. They can be used without modification on most tank, vessel and larger pipeline applications.

On applications where attachment is to be made to a small diameter pipe, fitting is easily modified by contouring the welding end with an acetylene torch to mate with the curvature of the pipe diameter.

Fittings are made with extra length and heavier wall to permit contouring without detriment to the strength of the fitting or the weld.

H K Porter Co, Inc, W-S Fittings Div, PO Box 95, Roselle, N. J.

Fluid control valves

607 • Units are suited for air, oil or water hydraulic use. They are designed for pressures of 200 to 5000 psi in sizes from ⅛ through ¾ in.

Unit combines two types of valves in one body design—a floating retro-ball check which provides full flow in one direction—a tapered fine thread needle which gives a wide range of adjustment of flow in the opposite or controlled direction.

Typical uses: inlet and exhaust speed control for double acting cylinders; speed control of cylinders in parallel; two-way speed control of a hydraulic pumping system. Request additional details.

Modrich Fluid Controls, Inc
458 Virginia St, Crystal Lake, Ill.

For more data on these items, use post cards on page 169. Identify your request with item number

A SUPER HYBOND arch was installed in a B & W coal fired boiler, with a chain grate stoker, in an Indiana Municipal light plant. The boiler is rated at 125,000 lbs. per hour, and operates at about 200% of rating. Prior to the use of SUPER HYBOND it was necessary to replace the arch in this boiler every 9 months. The SUPER HYBOND arch was not replaced for 3½ years and even then, as shown by the photos, could have given additional service.

SUPER HYBOND arch as installed.

A.P. GREEN

Super Hybond Suspended Arch Gives More Than 4 Times the Service of Previously Used Refractory Arch

SPECIFY A. P. GREEN PLASTIC FIREBRICK LININGS for longer life... lower maintenance costs

For over 30 years, A. P. Green plastic firebrick, made from highest quality Missouri fire clays, has been proved in service. Four grades of plastic to meet varying refractory needs.

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Look in the classified section of your telephone directory or write direct for the name of the A. P. Green distributor in your locality. He has complete stocks and can make prompt delivery.

SUPER HYBOND arch after 3½ years' service.

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REFRACTORY PRODUCTS

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Mexico, Missouri, U. S. A.

PLANTS: Mexico, Mo. • Woodbridge N. J. • Sulphur Springs, Texas
IN CANADA:
A. P. Green Fire Brick Company, Ltd., Toronto 15, Ontario

More EQUIPMENT NEWS

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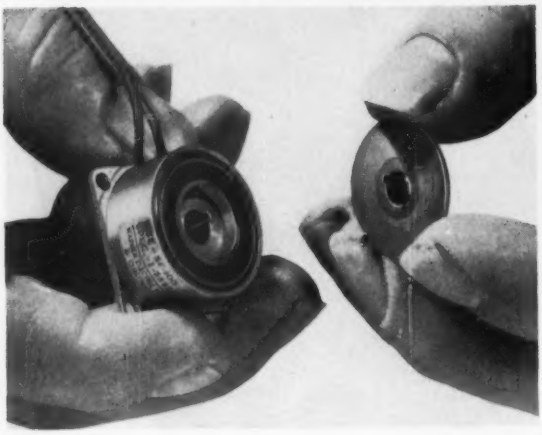
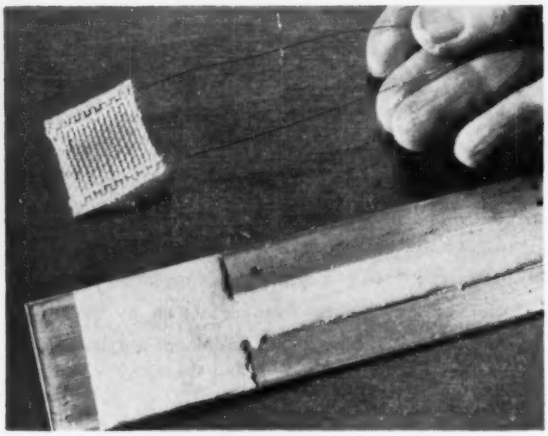


Miniature clutch needs no slip rings, brushes

610 • Electromagnetically operated miniature clutch is designed for use on low-torque drive of instruments and miniaturized control mechanisms. Designated as *Model SF-100*, it gives instantaneous positive engagement and release of loads up to two lb in. (static-torque rating). Axial length of unit is 7/8 in. and diameter is 1 1/8 in.

No slip rings or brushes are required since the flange-mounted field is connected through pigtail leads to a 28- or 90-volt dc source. Torque is transmitted through rotor to armature which may be keyed to the driving or driven member. Power required is six watts maximum. Request details.

Warner Electric Brake & Clutch Co, Beloit, Wis.

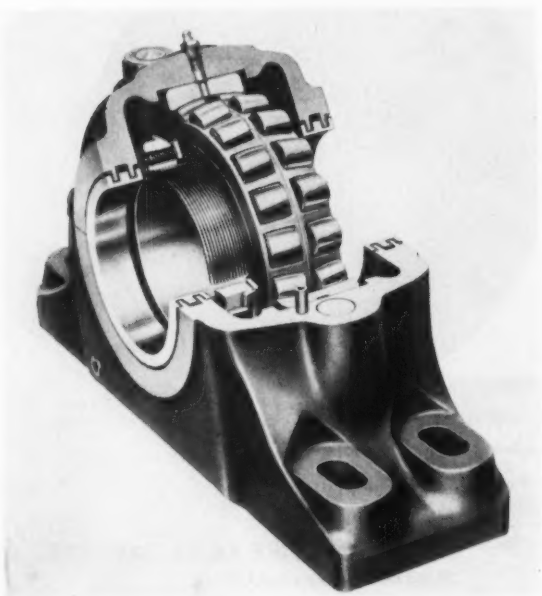


Refractory cement for –420 to 1000 F range

611 • *CA-9* refractory cement is claimed to hold metal to metal, glass or ceramics despite temperatures between –420 and 1000 F. The adhesive is dielectric and highly shock-resistant throughout its temperature range, the upper limit of which can be extended to 1500 F by modifying the composition. The material remains slightly malleable after drying, will not crack, craze or check even if used on a constantly flexing surface or to join materials with widely different thermal expansion coefficients.

CA-9 is waterproof, nonhydroscopic and unaffected by most reagents, according to manufacturer. Request details.

Charles Engelhard, Inc, 850 Passaic Ave, E Newark, N. J.



Pillow blocks have unique mount feature

612 • Spherical roller-bearing pillow blocks have new mounting feature that makes it possible to seat the bearings solidly on shafts quickly and easily. This is accomplished through use of set screws located parallel to bore in adapter nut. After bearing is snugged up with adapter nut, adjustment is completed by turning *Micro-Mount* screws against locking washer until bearing, adapter and shaft form an integral unit.

Manufacturer especially recommends unit for applications in which self-alignment and ease of installation and maintenance are prime factors.

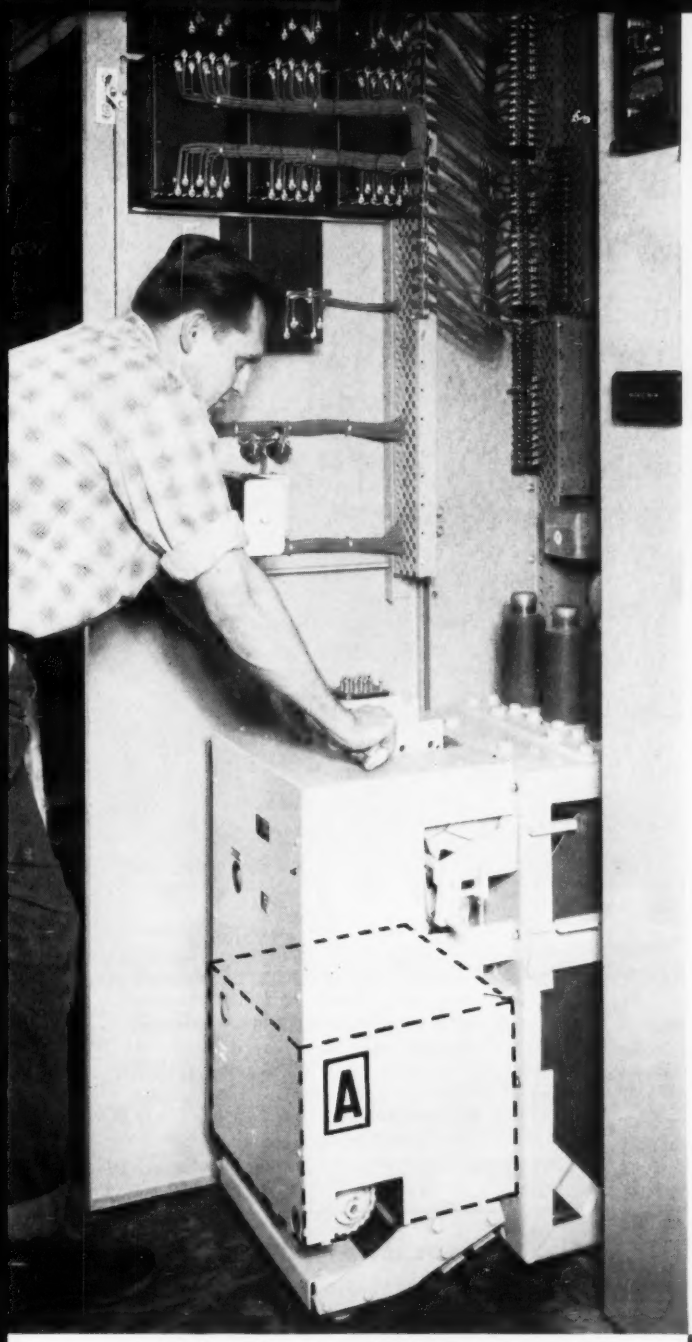
Pillow-block housing is built of close-grained semi-steel to withstand shock loads.

Feature of bearing design allows lubricant to enter at center of bearing and move outwardly along all bearing surfaces. Convenient drain plugs permit use of either grease or oil and provide for easy flushing. Triple seals retain the lubricant.

Dimensions of these pillow blocks are standardized, making them interchangeable with similar units. Both expansion and nonexpansion types are offered in sizes to fit shafts from 2 7/16 to 8-inch diameters. Request full details.

Dodge Manufacturing Corporation,
1957 William St, Mishawaka, Ind.

For more data on these items, use post cards on page 169. Identify your request with item number



A 90% cut in control power for Metal-Clad Switchgear

A stored energy closing mechanism, latest of the engineering and design developments which make General Electric your most modern metal-clad switchgear buy, now offers you a 90% reduction in control power requirement. Magne-blast circuit breakers with interrupting ratings of 150 MVA or over are optionally available with this mechanism.

Here's what this feature can do for you:

1. Eliminates requirement for 125 volt or 250 volt metal-clad operating battery.
2. Simplifies control power distribution system.
3. No high current voltage drop problems.
4. Permits simultaneous closing of any number of breakers without the high current problem.
5. Omission of AC closing rectifier eliminates associated maintenance and operating problems.
6. Built-in feature provides for safer, faster, manual emergency closing in event of loss of control power.

For additional information on this optional feature, write to Section 511-25, General Electric Company, Schenectady 5, New York.

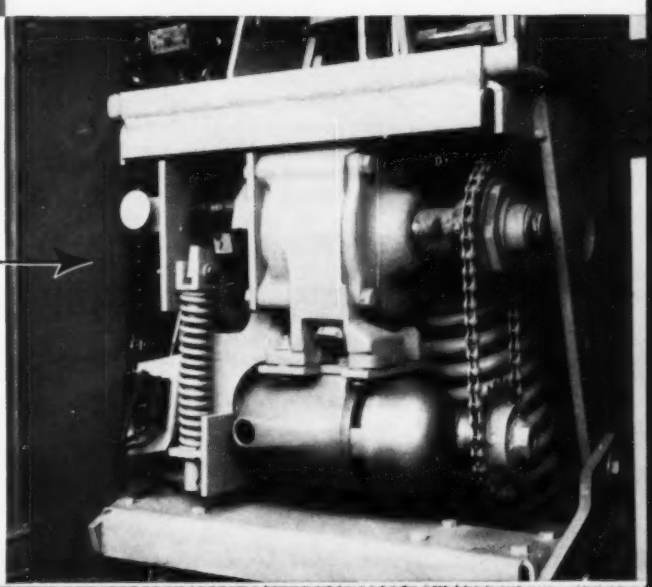
Progress Is Our Most Important Product

GENERAL ELECTRIC

IN ADDITION to the optional stored energy closing mechanism, General Electric Metal-clad Switchgear and Magne-blast breakers offer all the PLUS values of solenoid-operated equipment, such as Self-X insulation, and easy maintenance.

A

ENERGY IS STORED in powerful springs. To close a breaker, it is necessary to energize only a low-energy release coil with the control switch and the springs do the rest. The springs are recharged by a fractional horsepower gear-motor in a few seconds.



More EQUIPMENT NEWS

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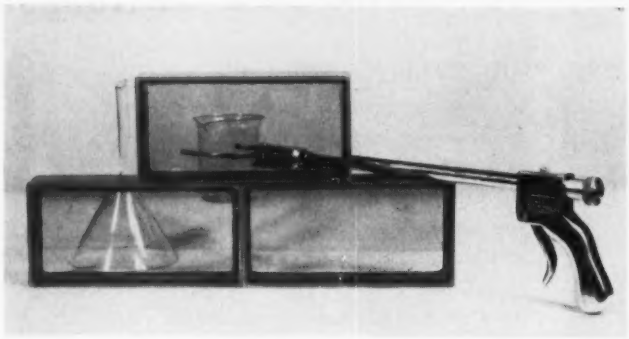


Peephole for atomic processes and experiments

613 • Glass shielding brick is said to be as dense as iron and 2/3 as dense as lead. Used as an insert in a metallic or concrete wall, lead glass brick enables the worker to observe the action, perform remote manipulations, and read instruments behind the wall shield.

Three sizes of brick are cast, including a large 8x8x4-in. square block for maximum viewing angle. Bricks are composed of lead glass mixture, and are mounted in a steel frame for protection and handling. For specific counting applications, upright cylindrical shields and interlocking doughnut types are also available.

The Atomic Center, Inc, 489 5th Ave, New York 17, N. Y.

Continuous monitor for airborne radioactivity

614 • Monitor is designed to indicate continuously the presence of airborne radioactive particulates. System is flexible in that it is designed to accept five different detectors, choice of which is determined by the type and level of radiation to be monitored.

The sampler draws a continuous air sample through a moving filter paper by means of a vacuum pump. Filter paper is said to have a collection efficiency of 98% or more for particulates larger than 0.3 microns. In regular operation the filter paper is moved past a detector at the rate of 1 in. per hour, but an additional speed of 3 in. per minute is provided to allow background measurements without disassembly of the unit. Additional details from manufacturer.

Tracerlab Inc, 1601 Trapelo Rd, Waltham 54, Mass.

Purifier cuts cost of removing radioactivity

615 • Disposable ion exchange unit measures 15 in. in diameter by 40 in. overall height and may be used for cation exchange, anion exchange, or mixed bed demineralizing; may also be used with granular activated carbon to filter and adsorb organic impurities.

Contaminated water is passed through the purifier, where the radioactive ions from the solution are exchanged onto the resin bed for non-radioactive ions from the resin. As a result, the radioactivity from the solution is adsorbed and concentrated on the resin bed. The solution that leaves the purifier is essentially free from radioactivity and may thus be safely disposed of or possibly recycled for reuse, says the manufacturer. Unit is said to be designed for compactness and for immediate installation. Request details.

Permutit Co, 330 West 42nd St, New York 36, N. Y.

General-purpose centrifugal pump

616 • Increased life and minimum maintenance are built-in features of *Pryco* pump, says manufacturer, since there are no grease fittings or packing gland to service after installation. The impeller is securely screwed on the threaded shaft which cannot work loose or get out of adjustment. Increased head and volume are said to be possible because heavy duty construction of the bearing allows for higher speeds.

Overall features of this centrifugal pump are: double ball bearings; mechanical shaft seals; heavy duty construction; lifetime lubrication.

Manufacturer claims that the all-iron construction of the unit makes it suitable for unlimited application in many fields.

E L Price Pump Co, Box 357, Sonoma, Calif.

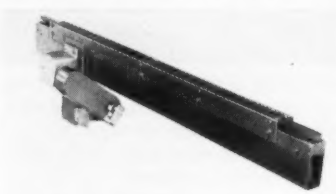
Double-acting hand pump

617 • Unit is suited for 10,000 psi hydraulic pressure. Unit has a patented internal toggle linkage and a capacity of .475 cu in. per cycle —more than three times the maximum capacity normally used.

Designed primarily for cranes, stackers, winches and other material handling applications, pump is normally used with a 28-in. length of ¾ in. pipe for a handle. Handle can move through a total arc of 72 degrees but is ordinarily operated through only half that distance. At 10,000 psi, operator will use the left hand portion of stroke for 3.5:1 mechanical advantage.

Mechanisms Co, 118 E 2nd St, Uhrichsville, Ohio

Be sure to check this item . . .

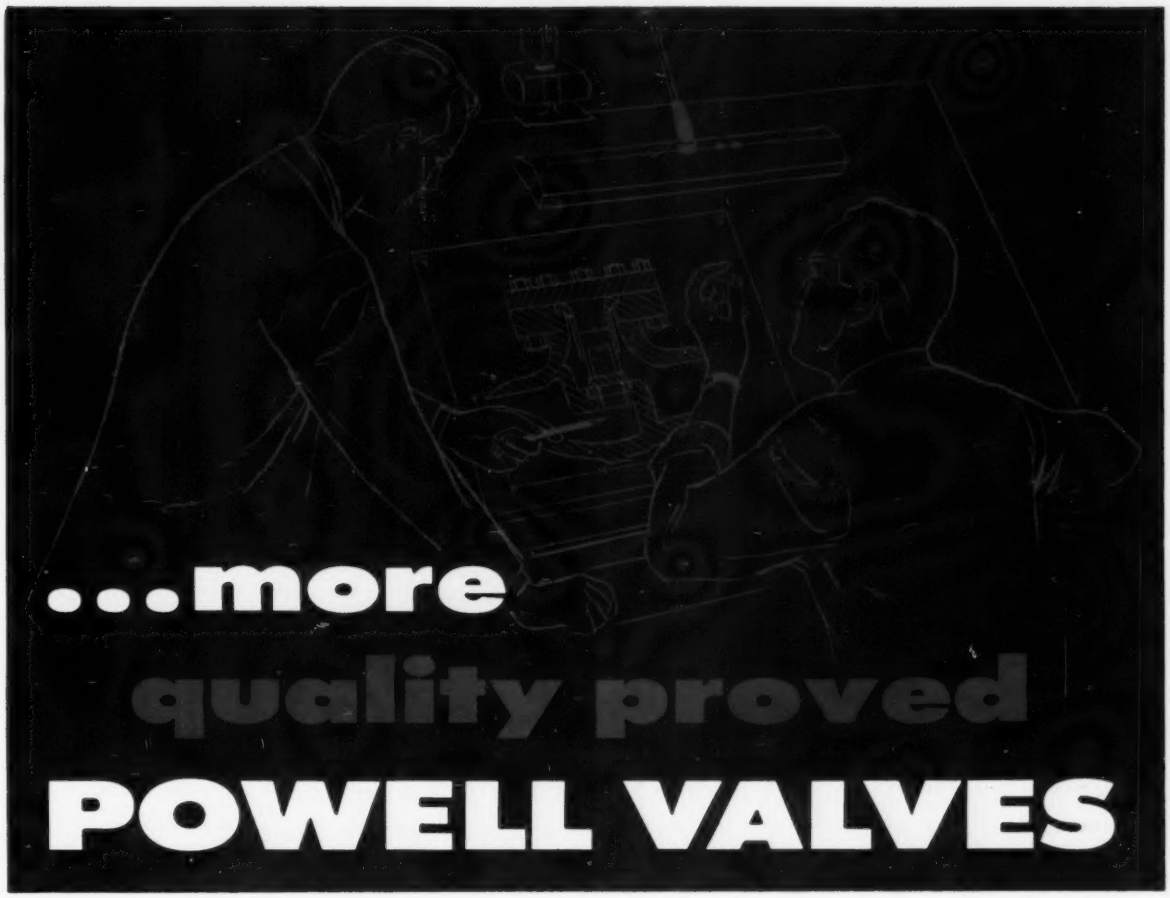


Adjustable transfer conveyor . . . p 174

. . . and these and the many others appearing on pages noted below:

Low noise chopper . . . . . p 178
Mobile air monitor . . . . . p 182
Control motor . . . . . p 192
Feedwater heater unit . . . . . p 196
High torque brakes . . . . . p 200
Corrosion resistant fans . . . . . p 204

In order to receive additional information on these new equipment items, use handy post cards provided on page 169. Identify your request with item number.



...more quality proved POWELL VALVES

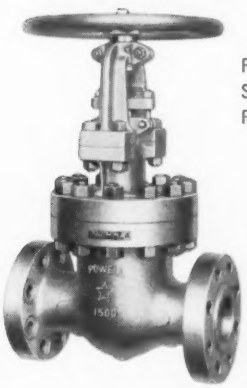


FIG. 1303 SS—1500-Pound Stainless Steel Gate Valve for handling Boiler Feed Water Treating Compound.

FIG. 3061 WE—300-Pound Steel Swing Check Valve.

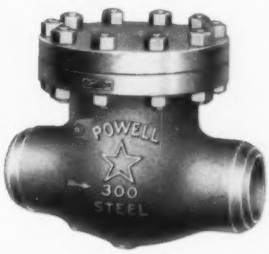
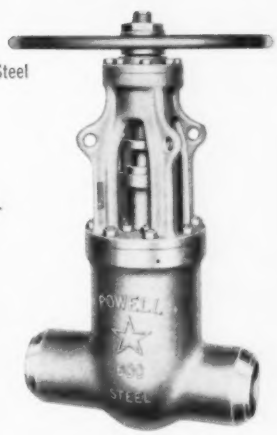


FIG. 16003 WE—600-Pound Steel Pressure Seal Gate Valve.

FIG. 1314 A—1500-Pound Integral Bonnet Steel "Y" Valve.

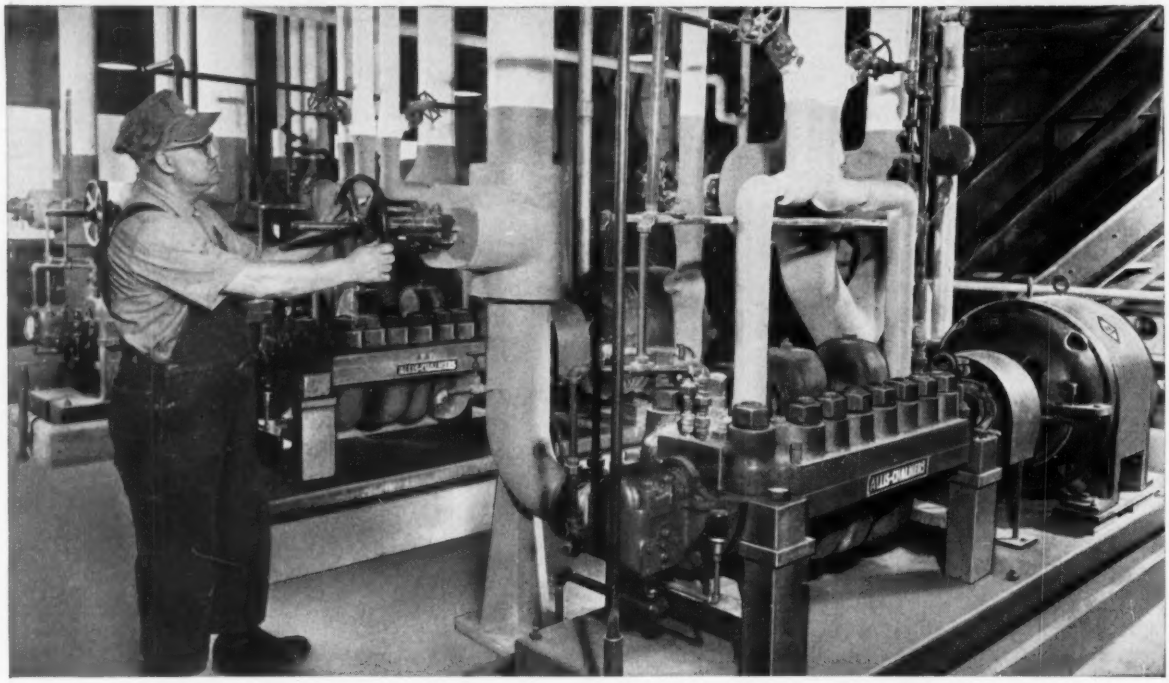


Designed for long life, designed for dependable service

Consult your Powell Valve distributor for all the facts about quality proved bronze, iron, steel and corrosion-resistant valves. No matter what the flow control problem, a Powell Valve can solve it . . . *better.*

THE WM. POWELL COMPANY, CINCINNATI 22, OHIO . . . 111th YEAR

Allis-Chalmers Pumps Meet Power Plant Requirements



New Pumps Give Milwaukee County Institutions

. . . Dependable Power Service

THESE modern multi-stage high pressure pumps assure continuous, economical steam for the Allis-Chalmers 3000-kw steam turbine units at the Milwaukee County Institutions.

As new members of the Allis-Chalmers complete line of pumps, these units are designed to meet medium-high pressure, continuous service requirements of boiler feed duty in lower volume ratings.

Horizontally split casing with suction and discharge in lower half provide for simplified maintenance—without disturbing piping. Both radial and axial balance maintains close clearances and fits, gives low thrust bearing loads. Bearings are double-row ball bearings or alternate sleeve bearing with Kingsbury thrust. Sleeve and Kingsbury combinations have ring oiling as well as pressure lubrication.

You get **MORE** than a Pump . . . When You Specify Allis-Chalmers

You can take advantage of Allis-Chalmers wide experience in supplying pumps to all industries. You are assured of modern design, heavy duty construction and correct application aid — all adding up to years of dependable service.

Allis-Chalmers is the only company that can offer you "One-Source" responsibility, with a complete unit — pump, motor and control — all built to work together. For "MORE" information about Allis-Chalmers pumps, call your local A-C office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

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To get more info on new equipment or FREE copies of latest bulletins

follow these easy steps

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more details on any item, write its number here →

New free bulletins are listed and numbered, beginning on back of this page. To order those you want, write POWER item number here — *do not use manufacturer's bulletin number.* →

Put 2¢ stamp on self-addressed card and mail it to us. We'll pass along your request to the various companies, they'll send the info

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REFRIGERATION, VENTILATING, HEATING

1 **Cooling tower** and heat exchanger are subjects of bulletin A-111B. Contains descriptions, specs, performance data on fans with blades in diameters from 40 to 132 in. and plastic blades from 10 to 22 ft. Hartzell Propeller Fan Co, Piqua, Ohio.

2 **Air-handling units** with automatic air filtration are described in 4-p illustrated bulletin 780. Dimension drawings and charts for basic unit and accessories are shown. American Air Filter Co, Inc, 215 Central Ave, Louisville 8, Ky.

3 **Motor-generator sets** and accessories for induction heating is subject of 8-p illustrated bulletin 28-750. Describes construction, operation, application of high-frequency motor-generator sets. Westinghouse Electric Corp, PO Box 2099, Pittsburgh 30, Pa.

CONTROLS, ELECTRICAL & MECHANICAL

4 **Regulator** for remote control of boiler feedwater in stationary and marine service is described in 4-p illustrated bulletin 1028. Discusses primary elements, shows schematic hookups of system. Copes-Vulcan Div, Blaw-Knox Co, Erie, Pa.

5 **H-p regulators** are subject of 8-p bulletin 1024-6. Contains descriptions, photos, drawings, capacity tables. Rockwell Mfg Co, Meter and Valve Div, 400 N Lexington Ave, Pittsburgh 8, Pa.

★ **Electromagnetic control** equipment is described in 170-p illustrated catalog. Contains electrical specs, constructional and operational information, dimensions and weights, standard and special features and ordering information. ★Request direct on company letterhead from Automatic Switch Co, Florham Park, N. J.

ELECTRICAL EQUIPMENT

6 **Current-limiting reactors** are subject of 16-p illustrated bulletin GEA-976D. Contains design and application data, ratings, dimensions and weights. General Electric Co, Schenectady 5, N. Y.

7 **Incandescent lighting** guide book is designed for commercial, industrial and residential lamp users. Illustrated 24-p booklet features sections on characteristics of incandescent lamps, structure, discussion of filaments, bulb sizes, glass types and finishes. Sylvania Electric Products Inc, 1100 Main St, Buffalo, N. Y.

8 **Transformer maintenance** is subject of 50-p pocket-sized booklet B-4716-B. Discusses general inspection procedures, classification of transformers, methods of drying out and transformer connections. Westinghouse Electric Corp, PO Box 2099, Pittsburgh 30, Pa. (*Continued on page 246*)

O-B VALVES

slip off the old disc holder . . . slip on the new

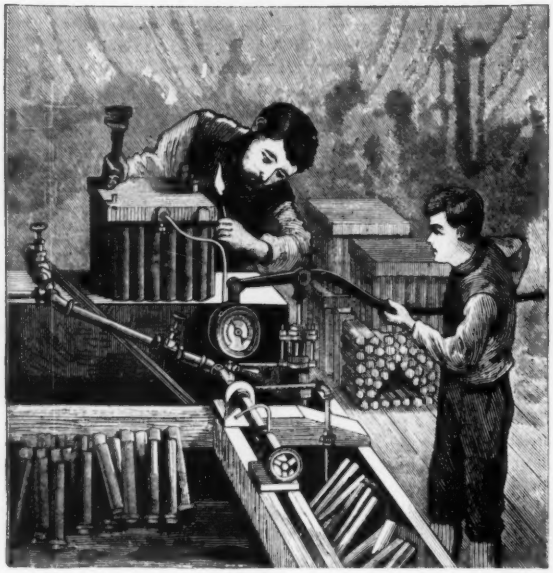
That is the way industrial maintenance men who know change discs on the No. 1101 O-B Globe valve. With just a few simple movements they have their production or service line back in operation with the least amount of lost time.

To do this they keep a supply of extra disc holders handy and when a disc needs changing they just switch disc holders. At their convenience they then remove the old disc from its holder and replace it with a new one, ready for the next change.

Ask your distributor about the No. 1101 O-B Globe valve with the replaceable disc holder. He'll gladly show you how it works.

OHIO BRASS COMPANY • MANSFIELD, OHIO

4723-V



George Edwards

Previews *Power's* 75th anniversary issue

► ILLUSTRATION, above, shows a shop hydrostatic test, to the "extreme" pressure of 300 psi, of a little boiler that was new in 1884. I ran across it in a copy of that year's September issue of *Scientific American*. And what am I doing reading 73-year-old magazines?

As you all know, POWER celebrates its 75th birthday this year. A special issue will be along in September and Editor Lou Rowley has his staffers operating as one-man task forces to get the material together. They're hopping all over the country, talking to equipment manufacturers and power-service engineers. Getting the latest dope on what's big news today—and what's coming, or likely to be, in the future.

In last month's editorial Lou invited POWER readers to be a part of the project. Many are taking him up on it, making some thought-stirring predictions about the power plant of 1990. All together, hundreds of fascinating facts are stacking up. I browsed through some of them when I visited with POWER last week, and this is how I happened to come across *Scientific American*, circa 1884.

The old magazines were sent in by Charley Willey, up in Penacook, N. H. They're in with the mountain of stuff from POWER's own back-issue files. All of it's being combed and culled for the "remember-when" part of the anniversary issue. This'll take many of us back to our slice-bar days, stir up some mighty pleasant memories.

As I moved down through the years to the present with POWER's files, the real meaning of "progress" stood out. I'm not trying to be original—far from it. But I'll bet that when you read the September issue, you'll think about it too; that there's no limit to what *free* people can do, when they *want* to.

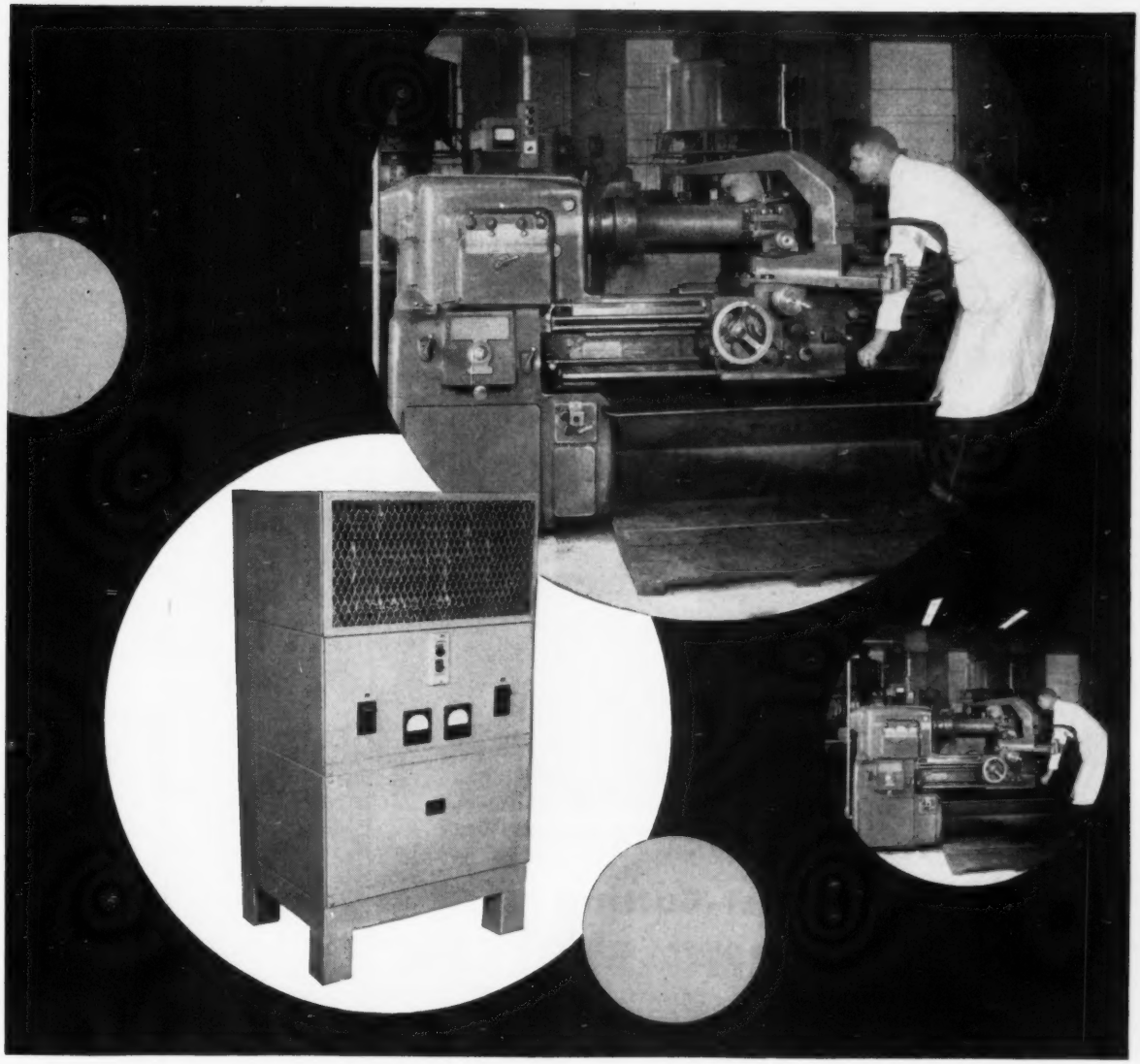
The older files are full of pictures and articles telling of "new" equipment and methods in the power-service field. As the years slide by, equipment and methods, often with basic principles unchanged, become bigger, lighter, faster, stronger, cheaper, more labor-saving. In a word—better.

Why? Because some guy had an idea, or wasn't satisfied with things as they were, or just plain wondered "what would happen if . . ." But this is just half of the story. The other half is he *did* something about it.

Whatever the future holds for the power-service engineer, and some of POWER's predictions look mighty exciting, it'll be reality only because we're convinced that we can do many things in new and better ways.

When you get your copy of the September issue, I think you'll agree that it's nothing short of a collector's item. And I know you're going to feel a little proud that you've been a part of the progress that made it possible.

What will September's POWER mean to the young fellow in the power-service field? He's luckier than he may realize. It's a pretty accurate blueprint of his future challenges and responsibilities.



Dependable D-C ON THE SPOT...economically

Here is the low-cost, low-maintenance way to have d-c power exactly where it's needed—and it's more efficient than any other type of power conversion unit.

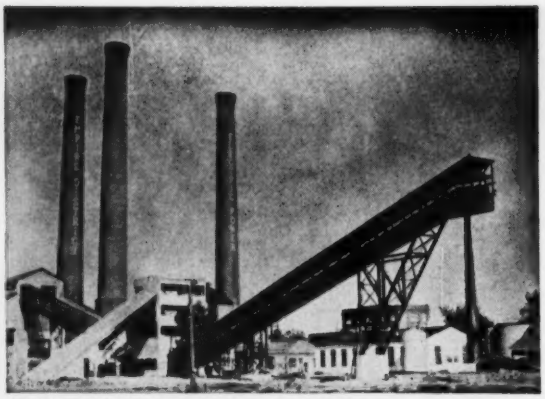
D-c power conversion units are available in ratings of ⅛ to 2 kw single-phase input and 1 to 100 kw three-phase input—ratings to meet your power requirements. And these units rely on long-lasting Rectox® selenium stacks which show less than 5% increase in forward drop after more than 16,000 hours of continuous life testing.

Westinghouse also furnishes a complete line of silicon units. For further information—call your Westinghouse sales engineer. Or, write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-22032

YOU CAN BE SURE...IF IT'S Westinghouse

EARN EXTRA PROFITS IN SAVINGS



McNally Pittsburg developed this 250 ton per hour system for the EMPIRE DISTRICT POWER & LIGHT CO.

McNally Pittsburg assisted in developing this 300 ton per hour system for the KANSAS POWER & LIGHT CO.

—With Cost-Cutting

COAL-HANDLING SYSTEMS

Engineered for Your Plant

Are you paying "extra fare" luxury rates for that last ride your coal must take from the truck, car, or barge, to your bunkers?

Why pay more? Why risk breakdowns, when you can *save* extra "profits" and be sure of year-round efficiency.

McNALLY PITTSBURG Systems automatically handle more coal per dollar—minimum maintenance costs.

The men who know coal from the ground up will be glad to study your coal-handling problems with you. Mail coupon.

McNALLY PITTSBURG

"The Men Who Know Coal From The Ground-Up"

McNally Pittsburg Mfg. Corp., Dept. PO, Pittsburg, Kansas
Gentlemen: Send more information on your Coal-Handling Systems.

Name_____ **Title**_____

Company_____

City and State_____

More EQUIPMENT NEWS

Begins on page 160

Adjustable transfer conveyor

630 • *Model 1000* conveyor speeds movement of cylindrical in-process work pieces of ⅛ to 1 9/16-in. dia between production machines and work stations. They can be used with centerless grinders and other similar production machines and inspection equipment.

Each unit includes a chain-belt conveyor, drive motor, variable-speed transmission and speed controls. Conveyor speed can be regulated between 5 to 20 fpm and feed of parts adjusted to speed of production machine.

Production Feeder Corporation, 3130 Johnnycake Ridge Rd, Mentor, Ohio

Standard-duty coupling

619 • Zinc die cast flexible coupling is designed for low-cost original equipment installation. It is said that installation, removal, assembly or disassembly can be quickly accomplished since the coupling consists simply of two bodies with jaws and a one-piece spider-type cushion.

Lubrication is not required. Dust and dirt, it is said, do not impair performance. Load is transmitted by cushion compression, thus saving wear on the metal jaws.

Lovejoy Flexible Coupling Co 4896 W Lake St, Chicago 44, Ill.

For more details on these items, use post cards p 169. Identify your request with item number.

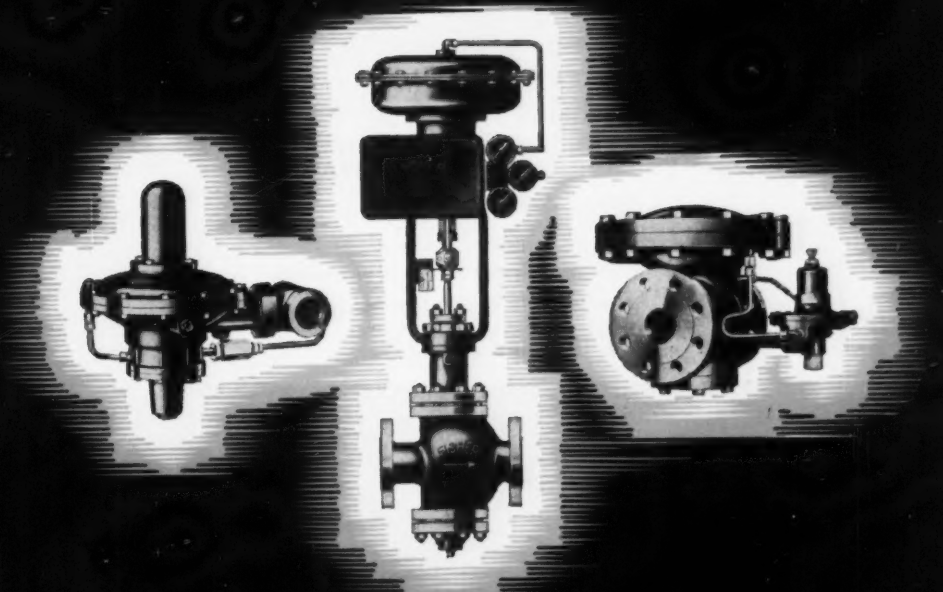
Radiant-heat unit

634 • Industries with production, space and cost problems in the application of heat energy for processing purposes will find a practical solution in this multi-frequency infrared process heating tube.

Manufacturer claims that this tube has wider application and greater superiority than conventional infrared filament-lamps and metallic-sheathed heaters because it produces a wider band of frequencies in the infrared spectrum—from 2,000 to 100,000 Angstrom units (2 to 10 microns) simultaneously and with a more efficient spectral distribution curve. It takes advantage of the fact that the degree of ab-

(*Continued on page* 178)

the tough Control Valve jobs go to



FISHER GOVERNOR COMPANY
MARSHALLTOWN, IOWA • WOODSTOCK, ONTARIO

USERS SAY R/M RUBBER PRODUCTS GIVE

Ray-Man Conveyor Belt... Lower Cost per Ton Carried

Cushioned strength members . . . with double compensation to relieve stress on outer plies . . . give Ray-Man Conveyor Belt unusual flexibility to permit fuller loads . . . even where relatively thick, narrow belts are used . . . or where pulleys are small. Holds fasteners under the most severe conditions. No breaker ply required. Use of newest synthetic super-strength fibers insures even greater service than ever before. Like all R/M heavy duty conveyor belts, Ray-Man is moisture resistant . . . mildew-proof . . . and protected against wear, tear, cuts and abrasions with R/M's exclusive and remarkably tough "XDC" Cover. Ray-Man cuts handling costs because it does a bigger job, better . . . and *lasts longer*.

Write for Bulletin #6915

● TRAINS NATURALLY

● RESISTS IMPACT

● DOUBLE COMPENSATION RELIEVES OUTER PLY STRESSES

Ask an R/M representative how these features of Ray-Man Conveyor Belt add up to lower cost per ton handled . . .

"More Use per Dollar"

YOU "*More Use per Dollar*"

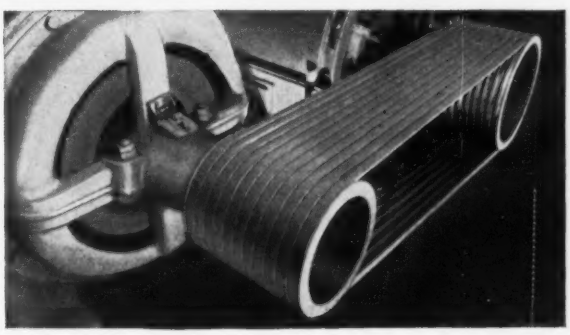
R/M Poly-V® Drive Delivers More Power in *Less Space!*

Unique patented design accounts for the extra power capacity of R/M Poly-V* Drive. A single, endless belt, with lengthwise parallel V-ribs running on sheaves designed to mate precisely with the belt ribs gives Poly-V high V-groove *grip . . . plus* flat belt *strength . . . twice* the tractive surface to deliver more power than ever before possible! Narrower sheaves can deliver *equal* power in as little as ⅔ the space required for a conventional V-belt drive . . . or up to 50% *more* power in the *same* space! This means *less* shaft overhang . . . *less* drive weight . . . *less* bearing load.

Poly-V eliminates multiple-belt "length matching" problems. Inventories of belts and sheaves are cut because just *two* belt cross sections meet every heavy-duty requirement.

The engineers who developed Poly-V Drive are prepared to work with you to determine the installation best suited for your heavy duty power transmission requirements. Contact an R/M representative...or write for R/M Poly-V Bulletin #6638.

**Poly-V is a registered Raybestos-Manhattan trademark.*



R/M Super-Power and Condor V-Belts ...the Smoothest Running V-Belts Made!

Straight sidewalls on these V-belts provide more grip, less slip, *longer* trouble-free performance. You can get up to 40% greater hp capacity with R/M Super-Power V-Belts as compared to standard types . . . or do an equal job with fewer belts!

Write for Bulletins

RM-7018

BELTS • HOSE • ROLL COVERINGS • TANK LININGS • INDUSTRIAL RUBBER SPECIALTIES

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

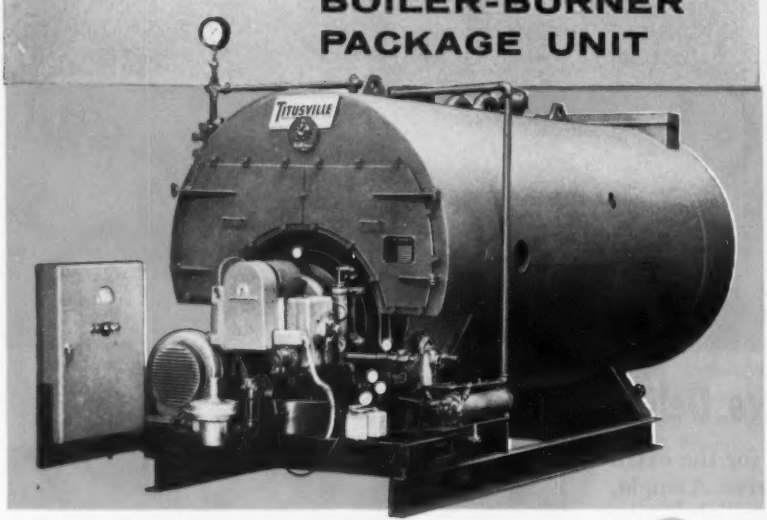
RAYBESTOS-MANHATTAN, INC.

Other R/M products: Abrasive and Diamond Wheels • Brake Blocks and Linings • Clutch Facings • Asbestos Textiles • Mechanical Packings • Engineered Plastics • Sintered Metal Products • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

NOW...THE TITUSVILLE

3pass

BOILER-BURNER PACKAGE UNIT



WITH 80% PLUS

CERTIFIED EFFICIENCY!

As pioneer and master-builder of Scotch Marine type boilers, TITUSVILLE is proud to present the 3-PASS boiler-burner package unit for high and low pressure and hot water. Offering the highest efficiency obtainable, these new 3-Pass boilers provide economy in service so great as to return the entire investment cost over a few years of operation. Designed for use with any of the leading makes of burners, and for gas, oil, or gas-oil combinations, Titusville 3-Pass boiler-burner units are available in ten sizes, with heating surfaces from 358 to 3571 sq ft. Write for the facts, and a quotation on your requirements.

THE TITUSVILLE IRON WORKS CO.

BOILER DIVISION
BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

PROCESSING EQUIPMENT DIVISION
Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

FORGE DIVISION
Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

MACHINERY DIVISION
MACHINERY for Sheet and Structural Metal Forming . . . Tangent Benders . . . Folding Machines . . . Roller Table and Tumble Die Bending Machines . . . Press Brakes . . . Punching and Notching Machines . . . Forming Dies

A Division of

Struthers Wells

TITUSVILLE, PENNSYLVANIA

Manufacturers of A Complete Line of Boilers for Every Heating and Power Requirement
Plants at Titusville, Pa. and Warren, Pa.
Offices in Principal Cities

More EQUIPMENT NEWS

Begins on page 160

sorption of any substance for infrared radiation varies.

The heating tube is available in various engineered radiant-heat panels and fixtures. Further data, complete specs available on request to maker.

Velotron, Inc
1186 Broadway, New York 1, N. Y.

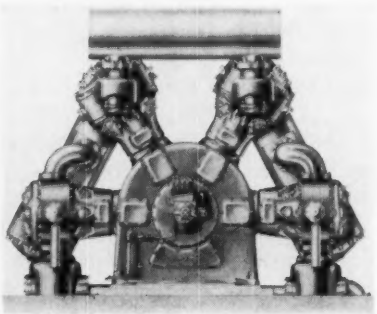
Low-noise chopper

622 • Unit is available in a low-noise external-coil model for dry circuit applications. Chopper has been designed, according to manufacturer, to eliminate the serious problem of capacitive coupling between contact and coil leads which exists in the operation of miniature choppers in high impedance circuits.

Unit is offered with spdt switch action.

The Bristol Company
127 Bristol Rd, Waterbury, Conn.

For more details on these items, use post cards p 169. Identify your request with item number.



Industrial air compressor

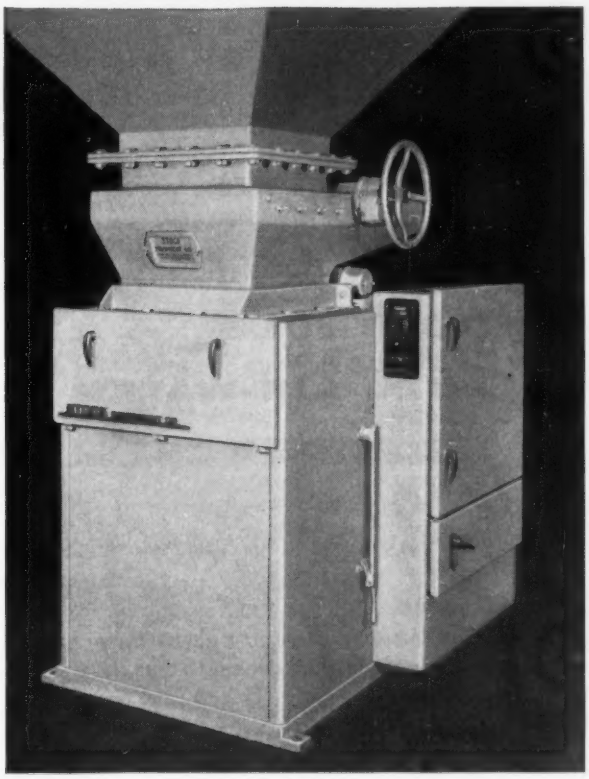
629 • Heavy-duty unit in the 350- to 1000-hp range is the largest packaged-type compressor available, according to the manufacturer. Output at 80-125 psig is rated from 2418 to 6048 cfm, depending on motor horsepower. The compressor is a 4-cylinder double-acting water-cooled machine of semi-radial design, achieving final pressure in two stages.

Three standard single models and three "Twin Unit" models are available, plus corresponding altitude sizes. Twin units consist of two standard compressors powered by one motor. High- and low-pressure variations of the new compressor are also

(*Continued on page* 182)

The new Stock Equipment Co.
Model 50 Coal Scale offers:

ACCURATE, CONTINUOUS COAL WEIGHTS... WITHOUT FAIL!



with little or no attention

Day-in and day-out operation, twenty-four hours on end without interruption, is a necessity for modern central stations and industrial power plants. The demand is for equipment to handle higher tonnages with less manpower—and Stock Equipment Co. is meeting that demand with a constructive design program that keeps its entire line up-to-date.

For example: The new Model 50 Coal Scale handles higher tonnages easily with its 500# stainless steel weigh hopper, extra wide feed belt and unrestricted flow of coal 24" wide straight through the scale. Anti-friction bearings are used throughout. Even the feed belt is carried on closely spaced idlers with anti-friction bearings carefully arranged for pressure lubrication from one point on each side.

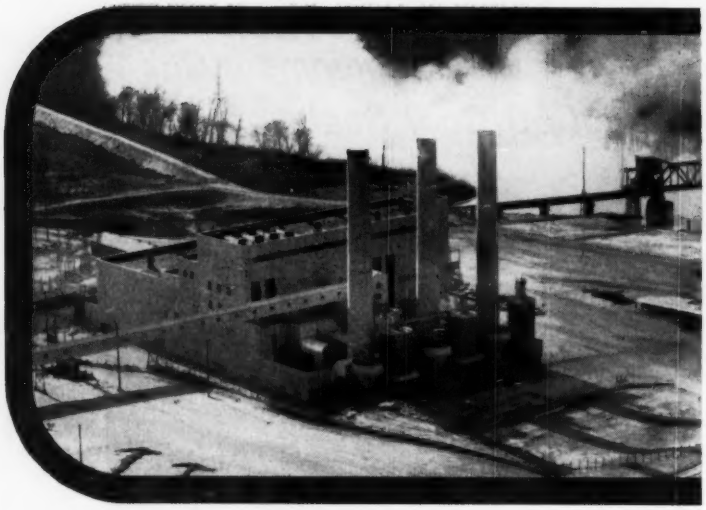
Seventeen years of designing scales exclusively for power plant use make a S-E-Co. Scale the answer to your coal weighing problem. Write for help with your particular layout of Bunker to Pulverizer or Bunker to Stoker equipment to the address below.

STOCK Equipment Company
745-P HANNA BLDG. CLEVELAND 15, OHIO

South Carolina Generating Company's

(Wholly-owned Subsidiary of South Carolina Electric & Gas Co.)

URQUHART STATION UNIT No. 3



where . . . **REPUBLIC** *Automatic*

COMBUSTION CONTROLS *Anticipate* **FUEL-AIR-WATER REQUIREMENTS!**

BRIEFLY—this is how it works:

Controls Respond First to Load Changes

REPUBLIC "Electronic Master" combustion control first detects any change in steam flow and immediately transmits a signal proportional to that change to the combustion air, coal pulverizers and/or gas valve, and feedwater valve.

Curb Pressure-Water-Temperature Changes

Corrective settings of each of these controls starts *with* the steam flow change and follows the change closely; this keeps steam, fuel, air, water and (of course) flue gas flows in the closest possible balance, minimizing fluctuations of header pressure, drum water level, and superheater outlet temperature.

Pressure Controls Follow Up

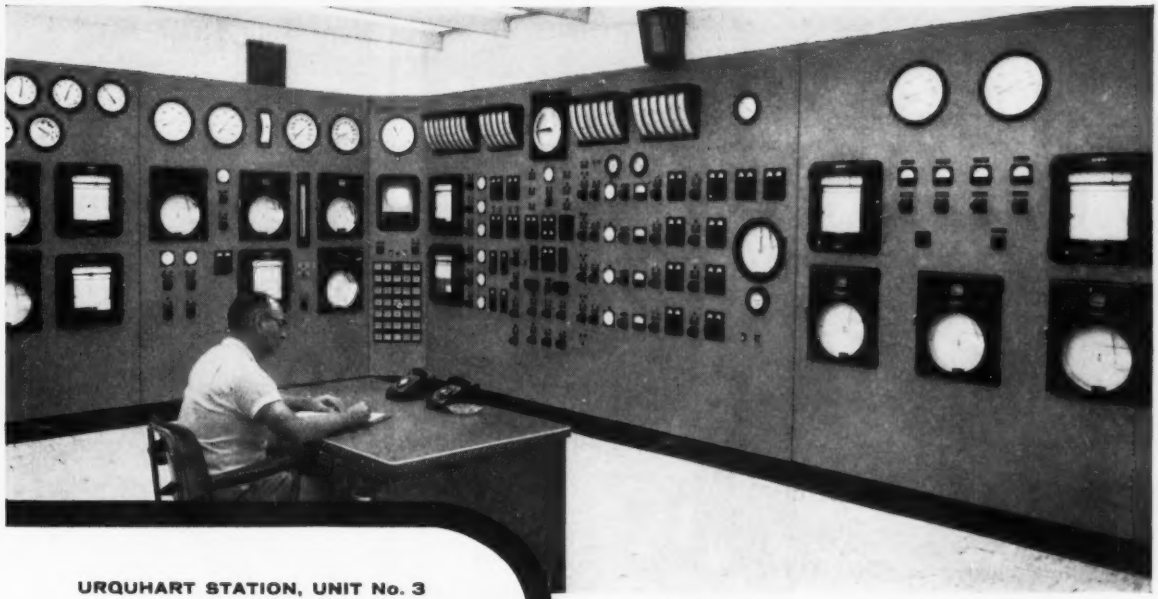
Any slight change of header pressure or drum level that *does* occur is immediately detected and fed to the proper control as a modulating signal that restores complete balance . . . quickly.

Combined Fuels—Stable Operation

This combination of flow-initiated and follow-up adjustments, with electronic control and pneumatic drive units, means top-notch stability, accuracy, sensitivity and reliability for Urquhart Station's Unit No. 3, even while burning combined fuels!

REPUBLIC FLOW METERS CO.

A Subsidiary of Rockwell Manufacturing Company



URQUHART STATION, UNIT No. 3
STEAM DATA:

Rated Capacity 700,000 LB/HR ——— 1825 PSI
SUPERHEAT 1010 F —— REHEAT 1010 F
FUEL: PULVERIZED COAL AND/OR GAS
COMBUSTION CONTROL:
REPUBLIC Automatic ELECTRONIC

Urquhart No. 3's control room where automatic and remote-manual controls are centralized.

Planned expansion of power for the great Southeastern United States is typified by the latest addition to Urquhart Station of the South Carolina Generating Co. Planned by Gilbert Associates, Unit No. 3 is modern today and will be modern tomorrow —*and will be considered "modern" by performance as well as appearance standards.*

REPUBLIC's "Electronic Master" combustion control is a logical partner in such advanced thinking. The quick, long arm of electronic control plus reliable, powerful actuation by pneumatics gives Urquhart No. 3 the reflexes it needs to meet any operating crisis and hold single—or combined—fuel consumption low. For greatest speed of control, REPUBLIC has provided a load-responsive system that regulates all combustion factors *before* pressure drops or jumps occur. Any pressure fluctuations following this advance adjustment are very limited and are promptly compensated by a pressure control system that modulates the fuel and air control signals.

REPUBLIC's three element feedwater regulator adjusts feedwater flow in proportion to steam flow, and follows up this action with a correction for drum level. Total level fluctuations are thereby held to a strict minimum.

Remote manual operation of any or all control units is possible at any time. The operator need only throw the transfer switch on his panel and take over; indicators at the operating station show electronic loadings to the regulators and positioners, and show the rate of response and position. All electronic amplifiers have built-in surplus capacity for extra life and special design features for quick maintenance when needed.

This comprehensive treatment of control problems is typical of REPUBLIC engineering. Equally thorough follow-up and servicing make REPUBLIC a helpful partner in new or modernized power operations—of any size.

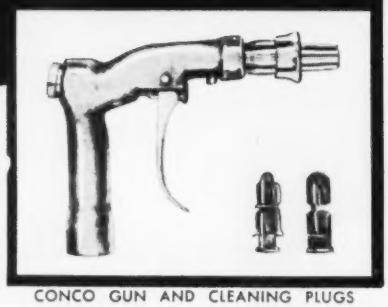
Need Help With "Early Stage" Planning? If you are planning ahead for new conventional or "unconventional" facilities, remember that REPUBLIC, too, is planning ahead. For help in projecting your new facilities in terms of new control, metering and recording equipment—and the latest in top quality valves—contact REPUBLIC's Engineering Department as soon as this help can be beneficial.

2240 Diversey Pkwy., Chicago 47, Illinois

CONSECO SPECIALTY ITEMS

MAKE YOUR POWER PLANT AND ENGINE ROOM

run Smoother



CONCO GUN AND CLEANING PLUGS

The Conco Gun and Cleaning Plugs economically keep steam condenser and heat exchanger tubes clean. They are typical of the many Conseco Specialty Items that guarantee economical, efficient Power Plant and Engine Room operation.

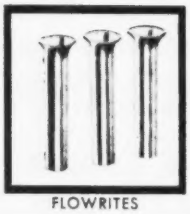
The famous Flowrites combat erosion at tube inlets. Fibre Plugs plug leaky tubes without any danger of air leakage through the material.

Bevel gear Universal Joints assure perfect remote control of high and low pressure valves, conveyors, window lights, ventilators, etc. in inaccessible locations.

Yes, every Conseco Specialty Item is backed by Conseco's thirty years of experience. Each is the best of its kind for its particular service.

Send for Specialty Bulletin — NOW

Get complete details of all Conseco Specialty Items for smoother, more efficient operation.



FLOWRITES

BEVEL GEARS

FIBRE PLUGS

FIBRE AND METALLIC PACKING

WIZARD INJECTOR

CONDENSER FERRULES

CONDENSER SERVICE & ENGINEERING CO., INC. CONSECO

Designers and Builders of Equipment for Power, Refining, Chemical and Marine Industries

164 OBSERVER HIGHWAY
HOBOKEN, N. J.

SEND FOR THIS STEAM CONDENSER CATALOG

to increase efficiency and cut power costs 18

CONSECO DESIGNS AND BUILDS

HEAT EXCHANGERS • CONDENSERS • FEED WATER HEATERS • PRESSURE VESSELS • EVAPORATORS • STEAM JET AIR EJECTORS • FILTERS AND STRAINERS • INSTRUMENTS • SEWAGE EJECTORS • CONDENSATE COOLERS • SPECIALTY ITEMS • ENGINE PARTS • SERVICE WATER COOLERS

Descriptive Bulletins Sent Promptly

More EQUIPMENT NEWS

Begins on page 160

available. Drive may be by electric motor, either flange-mounted or coupled, or by diesel engine, steam turbine or turboelectric combinations. Further data available on request to the manufacturer.

Joy Manufacturing Co
Oliver Building, Pittsburgh, Pa.

Mobile air monitor

628 • Unit, with fixed or moving filter, automatically measures and records airborne radioactivity and warns by light and bell when preset limits are exceeded.

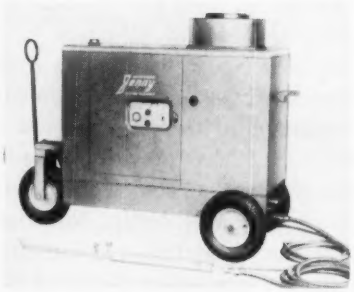
Known as *Model AM-3A*, the unit protects personnel wherever radioactive materials are handled. It detects the maximum permissible concentration of air-borne beta and gamma activity as specified in National Bureau of Standards Handbook 52.

The monitor will operate for 7 to 10 days unattended, providing a permanent legal record of radiation levels on a continuous chart.

Features include a variable air-flow positive displacement pump, high stability count rate meter, variable-speed chart recorder and 2-in. thick lead counting chamber. Dimensions are 47½x19x37½ inches.

Nuclear Measurements Corp, 2460 N Arlington Ave, Indianapolis 18, Ind.

p 169. Identify your request with item number. For more details on these items, use post cards



Heavy-duty steam cleaners

637 • *Series 1800* steam cleaners have 180-gph steam-cleaning capacity for removing dirt and grease from industrial machinery, material-handling and construction

(*Continued on page* 186)

DETROIT ROTOSTOKER TYPE C-C *(continuous cleaning)*

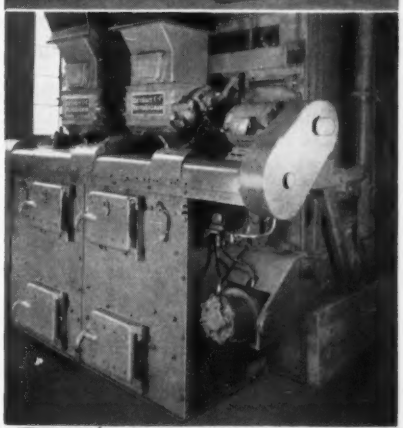
Makes a Hit WITH ENGINEERS

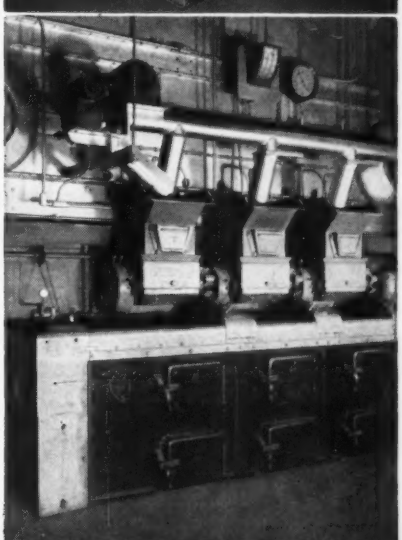
They're buying Detroit RotoStokers Type C-C because of these exclusive features:

- Cleans Fuel Bed and Discharges Ash Continuously at the Front
- Smokeless Operation Through Wide Load Range
- Efficiently Burns Bituminous Coals and Lignite
- Insures Continuous uninterrupted Steaming Capacity and High Availability
- Responds Quickly to Fluctuating Loads
- Fuel Feeders Handle High Moisture Coals Easily and Without Clogging
- Operation Automatic and Dependable
- Easily Applied to Existing Boilers—No Basement required
- Design Results in Low Maintenance
- Sizes Available to Develop from Approximately 5,000 to 75,000 Pounds of Steam Per Hour

DETROIT ROTOSTOKER TYPE C-C

6879





Detroit RotoStoker Type C-C *(continuous cleaning)* Installed or ordered for Steam Plants of:

Allied Chemical & Dye Corporation

Alpena Power Company

Auto-Lite Battery Corporation

Columbian Carbon Company

E. I. DuPont de Nemours & Company, Inc.

Frankenmuth Brewing Company

General Motors Corporation

Motor Products Corporation

National Gypsum Company

State of South Dakota

U. S. Atomic Energy Commission

U. S. Steel Corporation

Wake Forest College

Walter Brewing Company

DETROIT STOKER COMPANY

MAIN OFFICE and WORKS
MONROE, MICH.

District Offices or Representatives in Principal Cities

Uniformity of Republic ELECTRUNITE® Boiler Tubes

INCREASES ERECTION AND OPERATING EFFICIENCY

of Modern Steam Generating Equipment

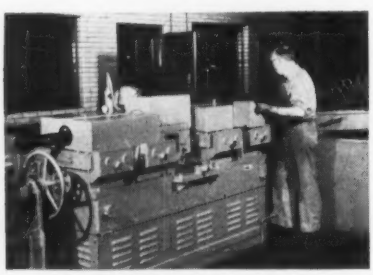
More power per dollar demands top efficiency in steam-generating-equipment design, erection, and operation. Materials used must meet these requirements and deliver long, trouble-free service as well. Republic ELECTRUNITE Boiler Tubes fulfill all conditions with flying colors.

The Riley "RX" Steam Generating Unit with Pressurized Furnace, at right, provides an excellent example. Designed and erected by the Riley Stoker Corporation, Worcester, Massachusetts, for the Phillips Petroleum Company Refinery at Sweeny, Texas, this unit develops 325,000 pounds of steam per hour at 500 psi. and 610° F. A total of 49,785 feet of Republic ELECTRUNITE Boiler Tube was used. Its uniformity made a significant contribution to construction economy, and assures long-term operating dependability.

Uniform quality throughout each tube is based on Republic's complete manufacturing control. The ELECTRUNITE welding process produces accurate size, concentricity, and wall thickness. Material-control, from ore to finished tubing, builds uniform strength and ductility into every length. Result is a fully predictable boiler tube that facilitates time-saving prefabrication techniques, easy "rolling-in" characteristics, and fast field assembly—and provides maximum service life.

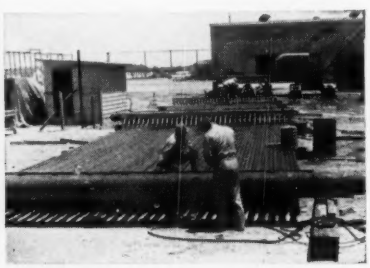
Republic ELECTRUNITE Boiler Tubes are hydrostatically or electronically tested to meet applicable ASTM specifications, the ASME Boiler and Pressure Vessel Code, and local, state, and boiler-insurance requirements. It is approved on an equal basis with tubes made by any other process, up to 850° F, and available for pressures over 2000 psi. in a variety of sizes and wall thicknesses.

For complete information on ELECTRUNITE Boiler, Condenser, and Heat Exchanger Tubes, contact your local Republic representative. For illustrated literature, mail coupon.



SPECIFY FARROWTEST®—the most conclusive, non-destructive tubing test in use today. Developed by Republic, FARROWTEST uses electronic detector coils to spot hidden irregularities in tube walls that would escape routine test procedures.

UNIFORM DUCTILITY AND CONCENTRICITY plus precise diameter assures easy installation of Republic ELECTRUNITE Boiler Tubes in drums. They slide in readily, roller-expand evenly, and bead over to form tight, weeper-free joints.

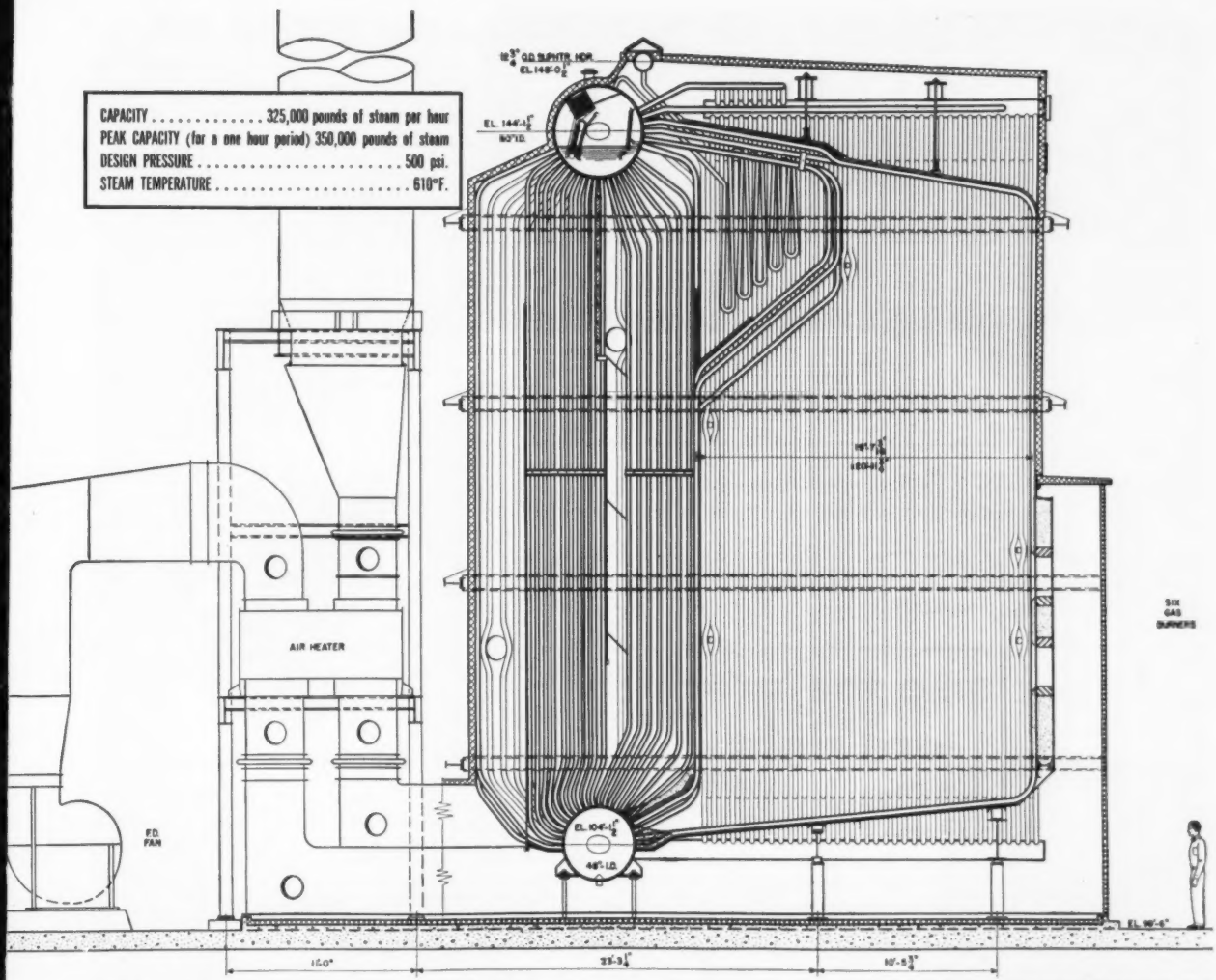


PREFABRICATION OF BOILER TUBE ASSEMBLIES was employed by Riley to speed erection of steam generator shown in diagram. Predictable characteristics of ELECTRUNITE simplified this operation, assuring easy bending to precise contours.

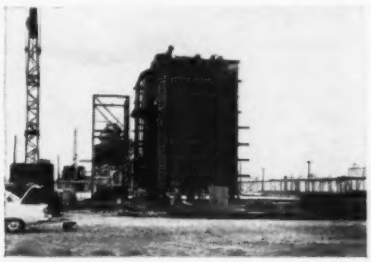
REPUBLIC

REPUBLIC STEEL®

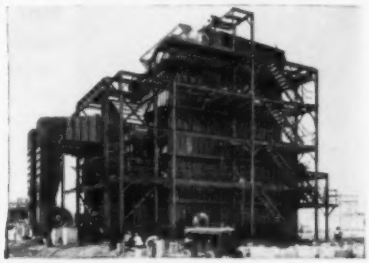
World's Widest Range of Standard Steels


CAPACITY . . . . . 325,000 pounds of steam per hour
PEAK CAPACITY (for a one hour period) 350,000 pounds of steam
DESIGN PRESSURE . . . . . 500 psi.
STEAM TEMPERATURE . . . . . 610°F.
AIR HEATER
F.D. FAN
SIX GAS BURNERS

HEADER WITH PRE-ASSEMBLED TUBING is quickly and efficiently raised into position by crane used for building construction. Beyond savings in time, this technique makes top quality of completed unit easier to achieve.



FINAL STAGES OF ERECTION include a careful inspection. Republic ELECTRUNITE Boiler Tubes provide maximum reliability throughout every length. There are no hidden thin spots to threaten service life or cause uneven heat transfer.



JACKET INSTALLED, Riley Steam Generator is virtually complete. Republic offers a handy guide outlining proper protection of boiler installations. Send coupon for wall chart entitled "Care and Maintenance of Boiler Tubing", today.

STEEL

and Steel Products

REPUBLIC STEEL CORPORATION
DEPT. C-3954
3144 EAST 45th STREET, CLEVELAND 27, OHIO

Please send:

- ☐ Illustrated booklet giving facts on ELECTRUNITE Boiler Tubes
- ☐ 8-page brochure on ELECTRUNITE Heat Exchanger Tubing ☐ carbon steel ☐ stainless steel
- ☐ Handy wall chart on care and maintenance of boiler tubes
- ☐ FARROWTEST brochure

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

D.T. Williams and DETROIT CONTROLS

the names are good

Reputation is a matter of record. And the record of D. T. Williams for dependability and performance has been firmly established over the years.

Now, as a part of Detroit Controls, the high quality is being maintained, so that you may continue to place your confidence in this product, assured of ready supply and good service.

because the products are right

No. 856 "Vulcodisc" Lift Check Valve

Vulcanized asbestos disc. For 200 lbs. working steam pressure at 500° F. or 400 lbs. working non-shock gas and liquid pressure at 150° F. Installed in horizontal position. Screw cap and screw ends.

No. 1086 Swing Check Valve

Vulcanized asbestos disc. For 200 lbs. working steam pressure at 500° F. or 400 lbs. working non-shock gas and liquid pressure at 150° F. Installed in horizontal or vertical position. Screw cap and screw ends.

No. 912 "Vulcodisc" Globe Valve

May be used for steam or hot water with pressures to 200 lbs., temperatures to 500° F.; or water, gas and air to 400 lbs. at 150° F.; for oil to 200 lbs. pressure at 250° F.

No. 833 Horizontal Check Valve

Renewable composition, air disc, integral seat, screw ends, spring loaded disc. 300 lbs. working non-shock gas and liquid pressure at 150° F.

These valves meet all government, marine and industrial specifications.

Bridgeport 1, Connecticut

DETROIT CONTROLS CORPORATION
Division of AMERICAN-Standard

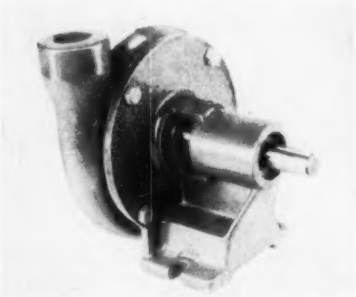
More EQUIPMENT NEWS

Begins on page 160

equipment. Units, designed for either single gun or two-gun operation, are available in stationary, portable or trailer-mounted types, either oil or gas fired. Where electric current is not available, units are offered with gasoline-engine drive.

Claimed features include automatic electric ignition, independent fuel system, slow-speed positive displacement pump with stainless-steel disk check valves, air-bell and alleviator hose for smooth quiet operation. Full facts and specs in bulletin 17-A-41, available from manufacturer.

Homestead Valve Manufacturing Co
Coraopolis, Pa.



All-iron centrifugal pump

631 • Increased life and minimum maintenance are claimed features of *Pryco* pump. There are no grease fittings or packing gland to service after installation. Impeller is screwed on threaded shaft to eliminate possibility of working loose or getting out of adjustment. Claimed features include double-ball bearings, mechanical shaft seals, lifetime lubrication.

All-iron construction makes pump suitable for industrial, commercial and air-conditioning applications.

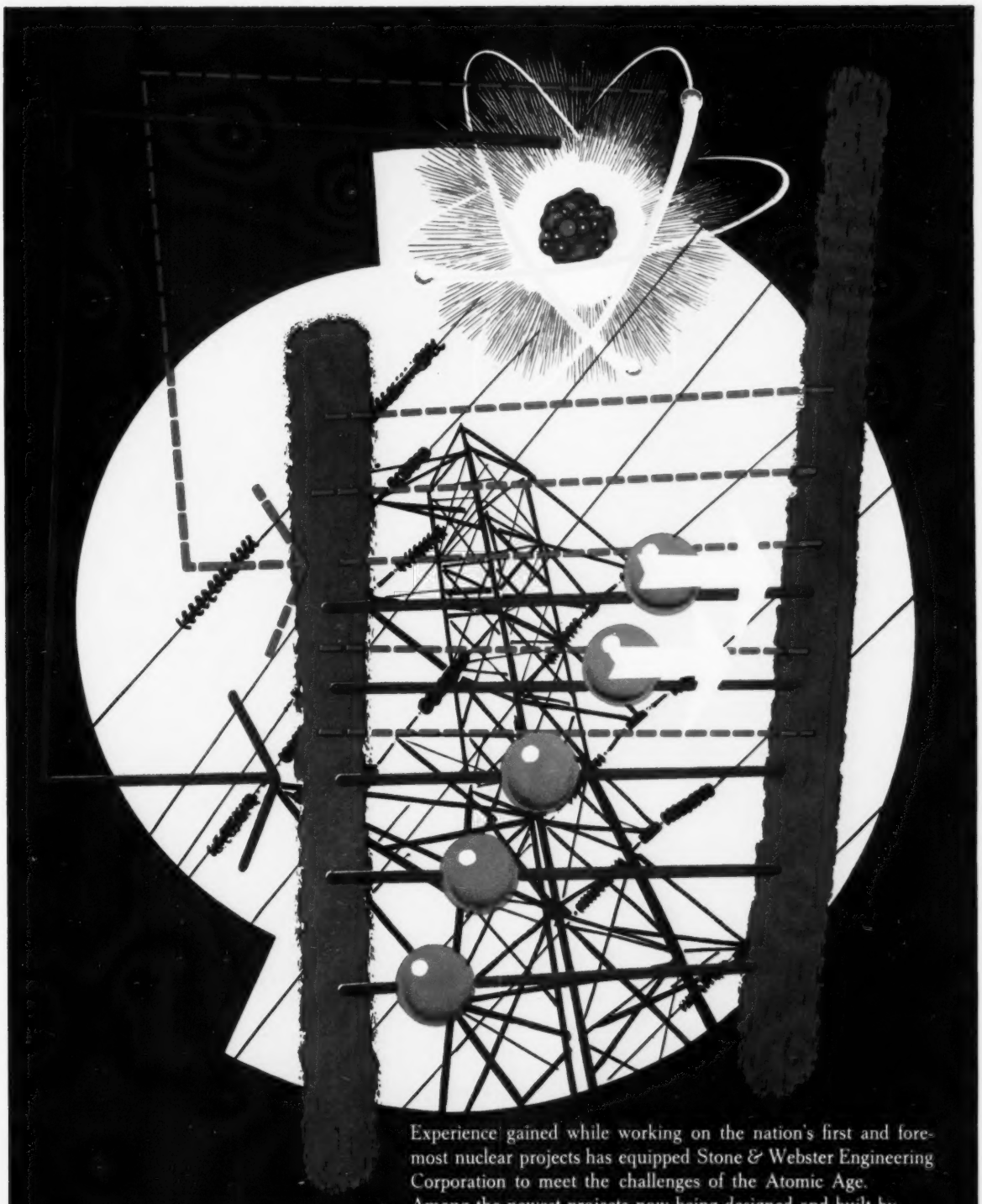
E L Price Pump Company
PO Box 357, Sonoma, Calif.

For more details on these items, use post cards p 169. Identify your request with item number.

Direct-reading vacuum gage

635 • Vacuum gages with single-contact relay control for auxiliary circuits are available for three general-use ranges.

(*Continued on page* 192)



Experience gained while working on the nation's first and foremost nuclear projects has equipped Stone & Webster Engineering Corporation to meet the challenges of the Atomic Age.

Among the newest projects now being designed and built by Stone & Webster, in partnership with Westinghouse Electric Corporation, is the 134,000 kw Yankee Atomic Power Project at Rowe, Massachusetts – a plant which will bring to New England its first source of electric power from atomic energy.

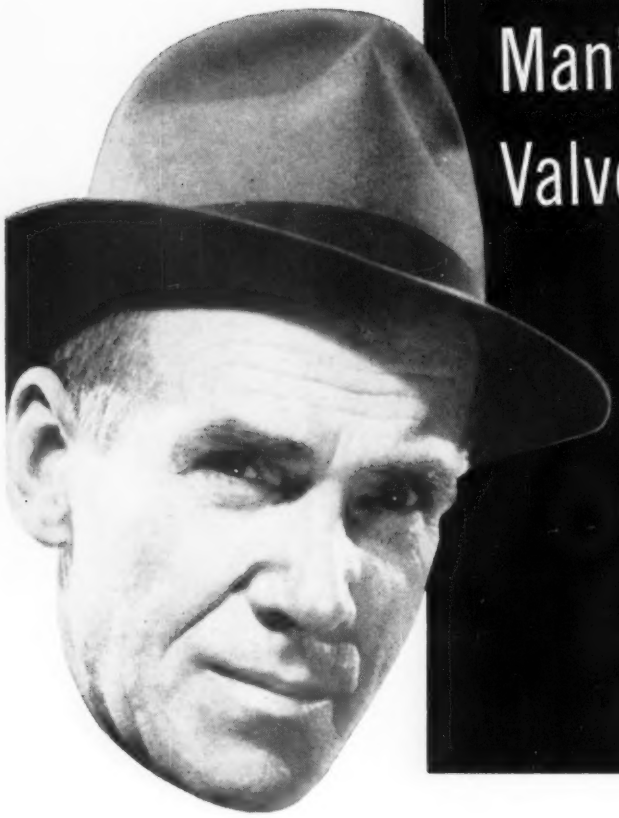
Write or call us for information as to how our experience can be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY of STONE & WEBSTER, INC.

New York • Boston • Chicago • Pittsburgh • Houston • San Francisco • Los Angeles • Seattle • Toronto

Valve Man's Valve...

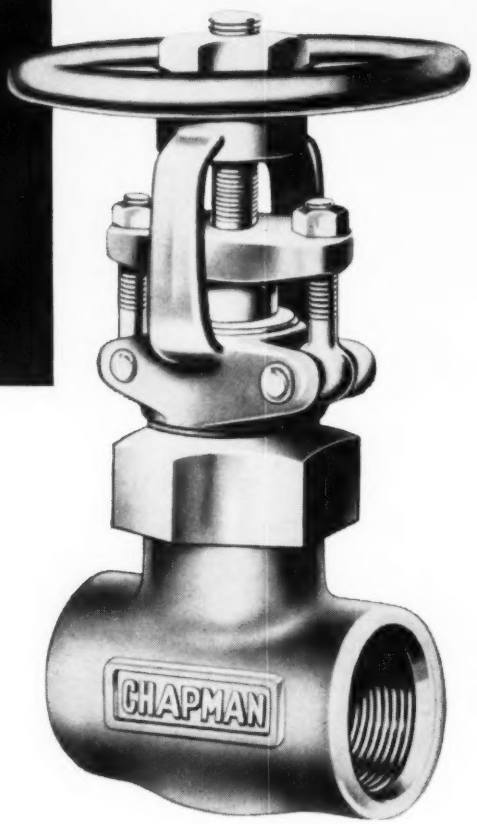


CHAPMAN

LIST 960

SMALL FORGED

STEEL GATE VALVE



There are good reasons why men-in-the-know specify Chapman List 960 for more jobs than other small forged steel gate valves. These reasons concern two important points . . . (1) long-range performance and (2) low-cost maintenance.

To begin with, Chapman List 960 valves have wedge faces that are super hard . . . tough enough for severe conditions. These wedge faces are hardened to 800 Brinell by Chapman's *exclusive Malcomizing process.* They can't seize or gall. And even the long-wearing, easily replaceable seat rings are made of hardened stainless steel.

There are no trouble-makers from top to bottom. No full-pressure repacking difficulties. No exposed threading.

For pressures from 380 psi at 1000°F. to 2000 psi at 100°F. (Anything higher, use Chapman List 990 valves.) Sizes range from ¼″ to 2″ . . . all in many alloy combinations. They come with rising stem with yoke or with inside screw. Bonnet joint ground metal to metal or gasketed, as you prefer.

You'll find them all . . . everything you want . . . in our Catalog 10. Write for your copy, now.

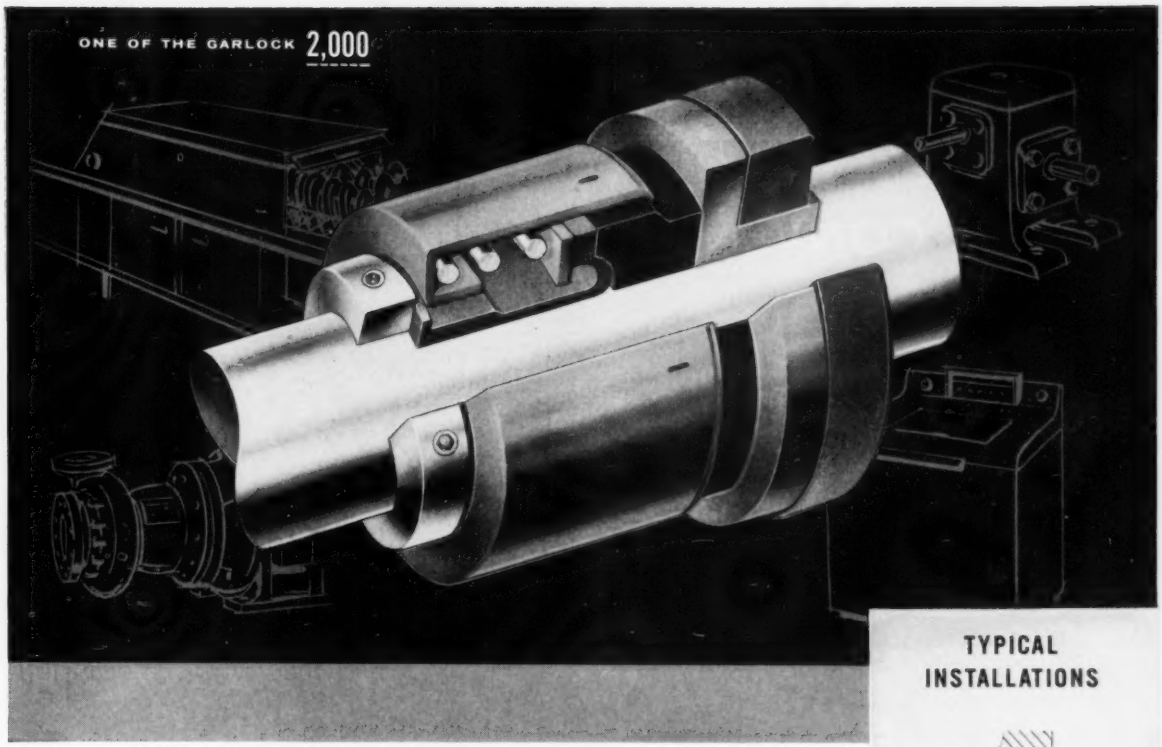
THE

CHAPMAN

VALVE MANUFACTURING COMPANY

INDIAN ORCHARD

MASS.



THE PACKAGED SEAL
of a hundred uses

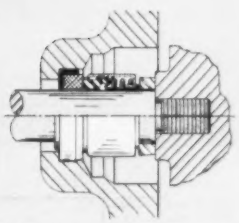
This Garlock MECHANIPAK* Seal BB-21A has proved itself on hundreds of jobs, sealing against water, oils, alcohol, mild acids, and solvents. It's ideal for shafts on centrifugal pumps, automatic washers, speed reducers, commercial dishwashers . . . wherever pressures do not exceed 150 psi.

Withstands temperatures to 212° F. with standard bellows or up to 400° F. with silicone rubber bellows . . . shaft speeds to 2000 fpm and higher depending on operating conditions. Sizes for 3/8" to 3" dia. shafts. Mechanical drive arrangement is engineered to eliminate slippage and simplify installation.

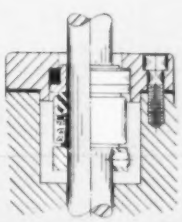
The BB-21A is another important part of "the Garlock 2,000"... two thousand different styles of packings, gaskets, and seals to meet all your needs. The only complete line. That's why you get unbiased recommendations from your Garlock representative. Call him today or write for Catalog AD-150.

*Registered Trademark

TYPICAL INSTALLATIONS



Centrifugal pump installation where stationary seat fits in housing and impeller provides stop for seal. A cup type vibration ring holds stationary seat. (Vibration ring design optional.)



Vertical shaft installation where lock-nut positions seal on shaft and stationary seat is in gland. A square vibration ring is used to hold stationary seat. (Vibration ring design optional.)

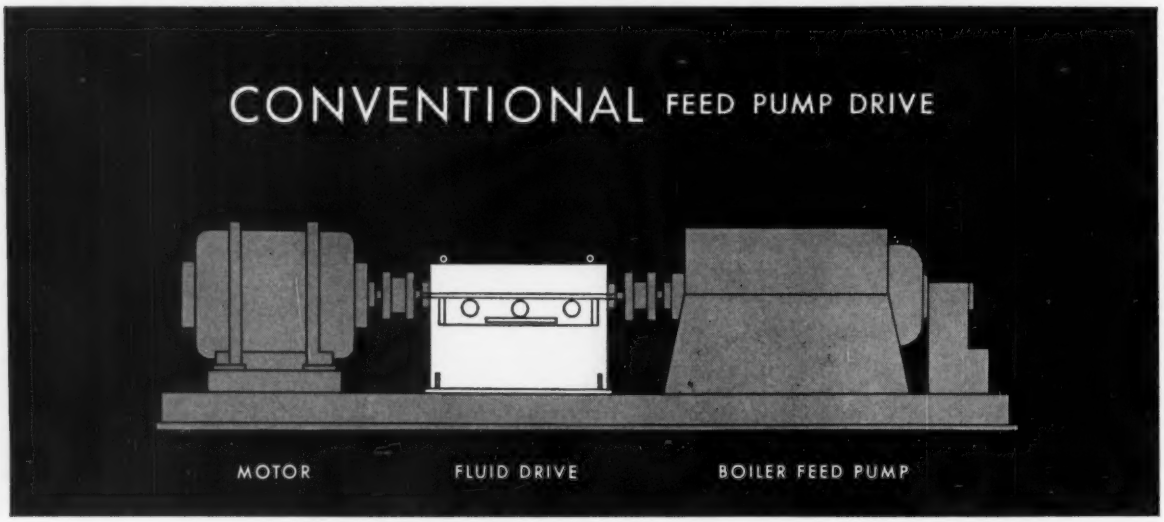
THE GARLOCK PACKING COMPANY, Palmyra, N. Y.

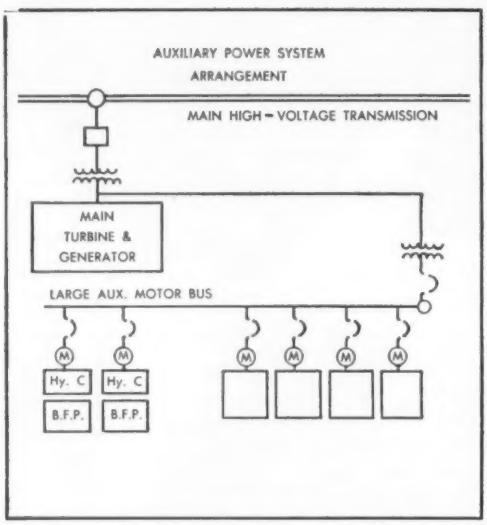
For prompt service, *contact one of our 30 sales offices and warehouses throughout the U. S. and Canada.*

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints, Fluorocarbon Products

How *Gýrol*® Fluid Drive meets all

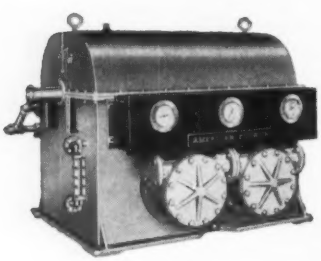




Of all power-plant auxiliaries, the boiler feed pump consumes the greatest single segment of invested power. To release more of this power to consumer lines, power plants of all sizes are controlling feed water flow by speed regulation through Gýrol Fluid Drive – driven by a constant speed prime mover.

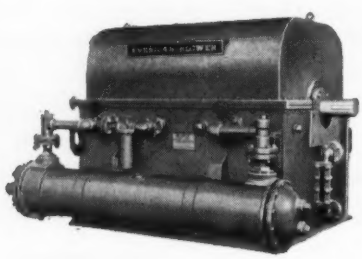
Gýrol Fluid Drive offers several specific advantages:

1. It saves power over the entire operating range by eliminating wasteful throttling by valves.
2. Fluid Drive's adjustable-speed feature permits reduction in pressure – resulting in further power savings.
3. It reduces wear on bearings, and other vital pump parts, by letting the pump operate at speeds that fit boiler demands.
4. With Fluid Drive, paralleling of pumps is simplified. Change-over from operating to standby pump is quick and easy.
5. Quiet operation is inherent in the design of Fluid Drive, since a "cushion of oil" is the means of energy transmission.



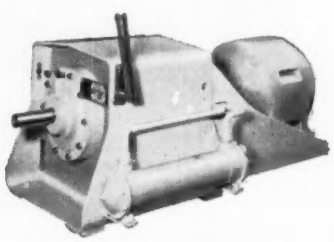
TYPE VS CLASS 6

- adjustable speed control
- 250 to 12,000 horsepower
- speeds to 3600 rpm



TYPE VS CLASS 4

- adjustable speed control
- 100 to 2500 horsepower
- speeds to 1800 rpm

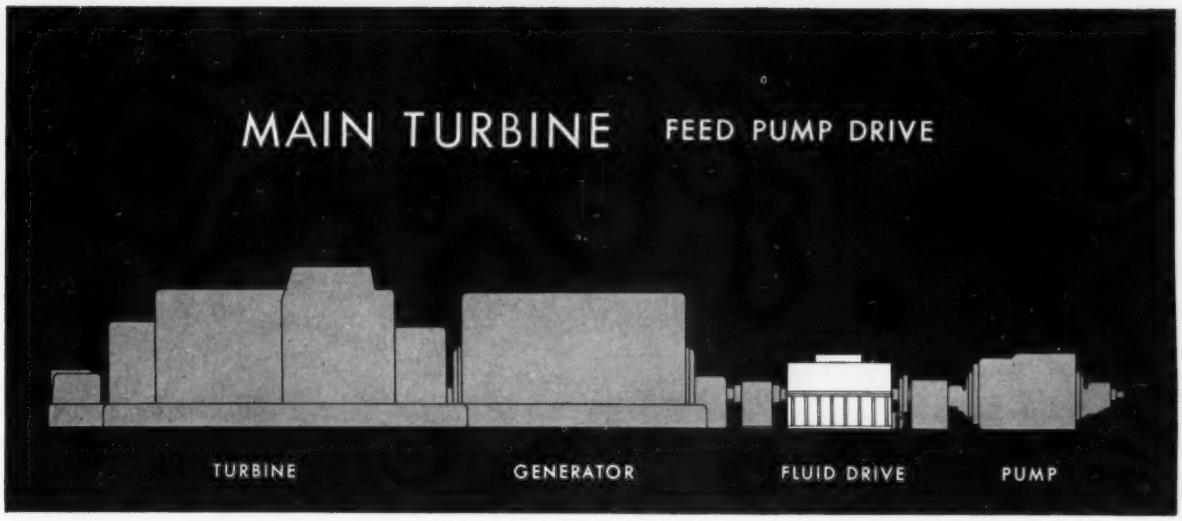


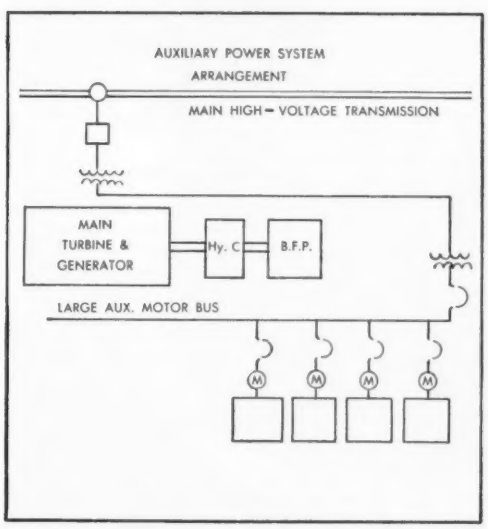
TYPE VS CLASS 2

- adjustable speed control
- 1 to 800 horsepower
- speeds to 1800 rpm

requirements for feed pump control

Regardless of station size, arrangement, or prime mover, you get the advantages of power savings, reduced pressures, and quiet operation with American Blower Gýrol Fluid Drives





Already in the construction stage is the use of Gýrol Fluid Drive for main turbine feed pump drives on some of the largest generating units yet projected.

For example, two of these stations will each drive, through a 12,000-hp adjustable-speed Gýrol Fluid Drive, the main feed pump from the high-pressure turbine. Full boiler capacities will be supplied by the single 5-stage pump, each delivering 6330 gpm against 6400 feet total discharge head when operating at 3510 rpm with feed water at 363° F.

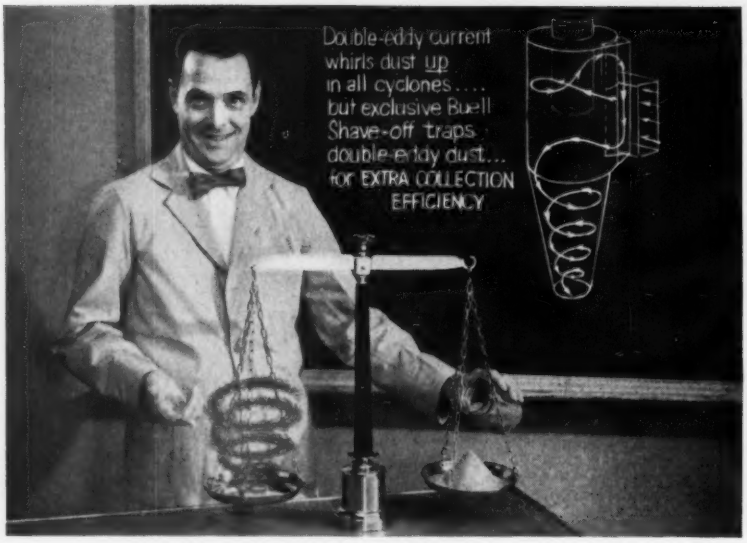
Each pump requires an excess of 11,000 hp, and will be driven from the generator shaft through an adjustable-speed Gýrol Fluid Drive.

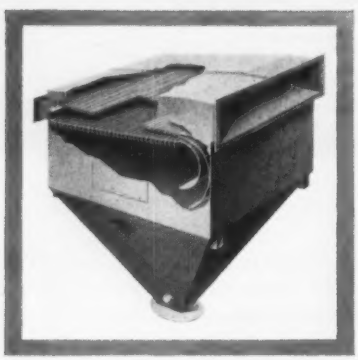
In your plans for expansion, why not discuss the advantages of Gýrol Fluid Drive with an American Blower engineer. His knowledge of this application in modern power plants may prove valuable to you. Call our nearest branch, or write: American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

AMERICAN BLOWER

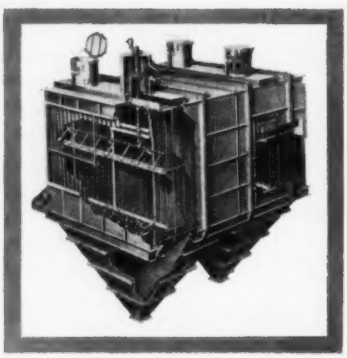
Division of AMERICAN-Standard

How Buell's Shave-off tips the scales for Extra Dust Collection Efficiency


Double-eddy current whirls dust up in all cyclones.... but exclusive Buell Shave-off traps double-eddy dust... for EXTRA COLLECTION EFFICIENCY



Side entry of dust-laden gases through Buell-designed manifolds minimizes turbulence, raises efficiency even higher in Buell cyclones. Large-diameter design eliminates clogging and bridging. Heavy plate construction assures years and years of extra service life without repair or replacement.



Buell's Low Resistance Fly Ash Collector combines top efficiency with low draft loss, for either natural or mechanical draft installations. Ideal for boilers from 100 to 2000 BHP.

SF Electric Precipitator, a Buell exclusive, also delivers *extra efficiency* due to unique Spiralectrodes and Continuous Cycle Rapping of collecting electrodes.

For more specific data about Buell's *extra efficiency*, write Dept. 50-F,
Buell Engineering Company,
70 Pine Street, New York 5, N. Y.

buell®

MECHANICAL ELECTRICAL

Experts at delivering Extra Efficiency in
DUST COLLECTION SYSTEMS

More EQUIPMENT NEWS

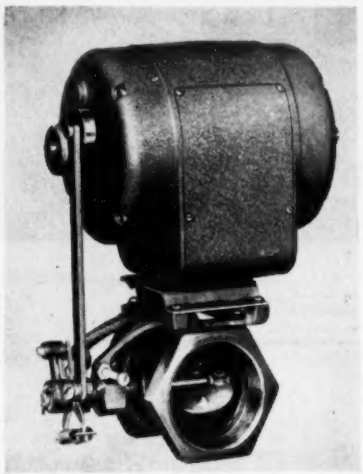
Begins on page 160

Ranges are 0 – 100 microns Hg, 0 – 1000 microns Hg and 0.1 – 20 mm Hg.

Adjustable contact arm on the meter can be preset for control at any point within the instrument's range. Contact closes when the vacuum pressure reaches the preset position. This activates a single-pole double-throw relay to auxiliary circuits having a total capacity to 5 amps at 125 volts. The instrument continues its control until pressure is brought back into the selected range and contact released by manual reset. Relay circuit is suitable for operating pumps, alarm lights, control units, etc in the vacuum system.

Special advantages claimed by manufacturer include upper or lower limit control, internal voltage regulation, rapid response to system changes, direct-reading logarithmic scale and gage tubes unaffected by exposure to atmospheric pressure.

Hastings-Raydist, Inc, Hampton, Va.



Control motor

624 • Reversing capacitor electric motor is designed to operate rotary, slip-stem and butterfly valves, dampers and other final elements in automatic control systems.

Unit is manufactured in two basic models. One is designed for two-position and floating control; and the other for positioning control. Units are approximately 6 in. in diameter, 10 in. wide and weigh 11 lb.

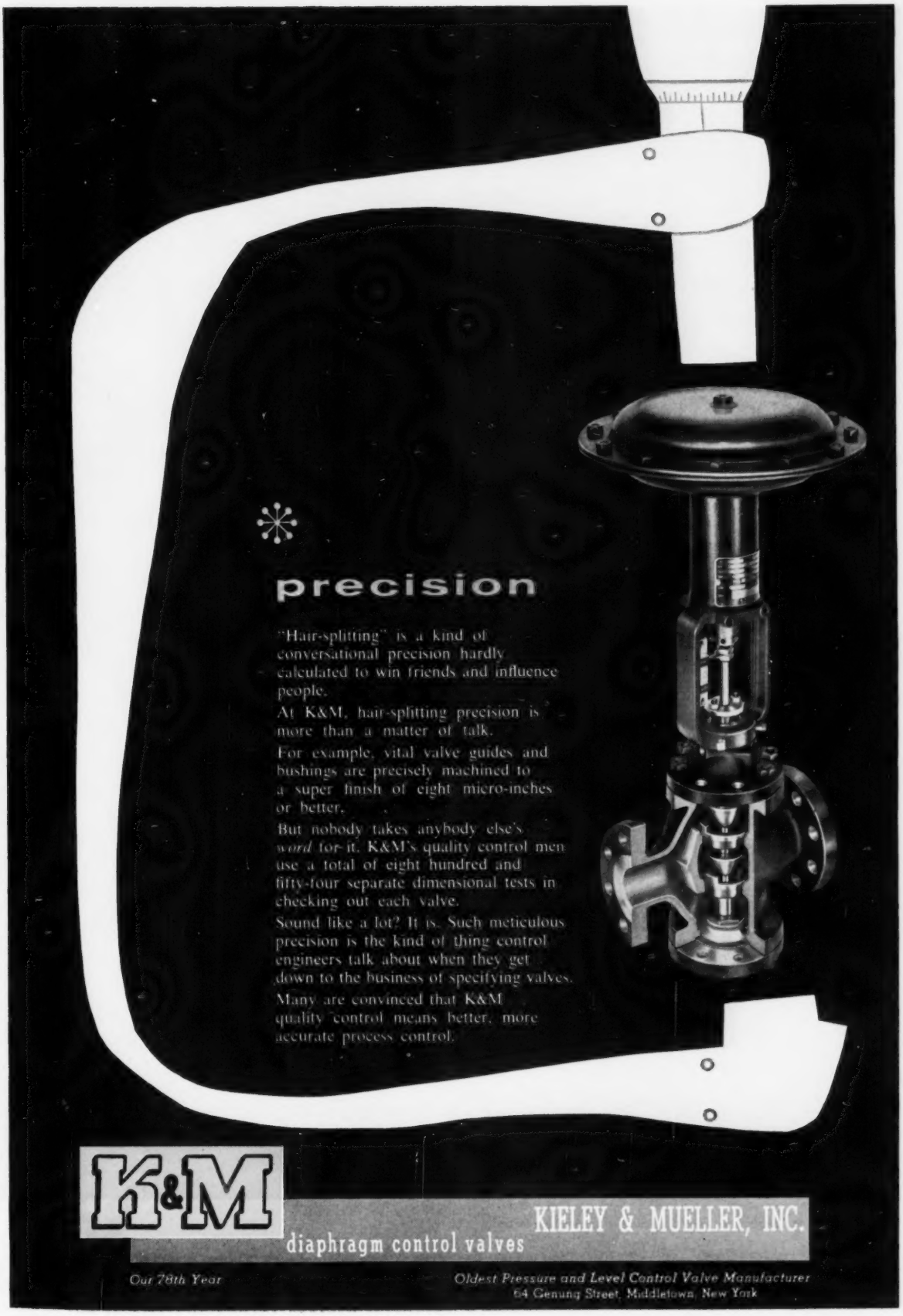
Minneapolis-Honeywell Regulator Co, Industrial Div, Wayne & Windrim Aves, Philadelphia, Pa.

For more details on these items, use post cards p 169. Identify your request with item number.

Multiple feed oilers

625 • Units have tapered feed adjustment screws which are said to afford more accurate feed control. Leak-proof friction fit of these adjusting screws eliminates the need for lock nuts, says the manufacturer. Operator can, therefore, make quick fin-

(*Continued on page* 196)



precision

"Hair-splitting" is a kind of conversational precision hardly calculated to win friends and influence people.

At K&M, hair-splitting precision is more than a matter of talk.

For example, vital valve guides and bushings are precisely machined to a super finish of eight micro-inches or better.

But nobody takes anybody else's *word* for it. K&M's quality control men use a total of eight hundred and fifty-four separate dimensional tests in checking out each valve.

Sound like a lot? It is. Such meticulous precision is the kind of thing control engineers talk about when they get down to the business of specifying valves.

Many are convinced that K&M quality control means better, more accurate process control.

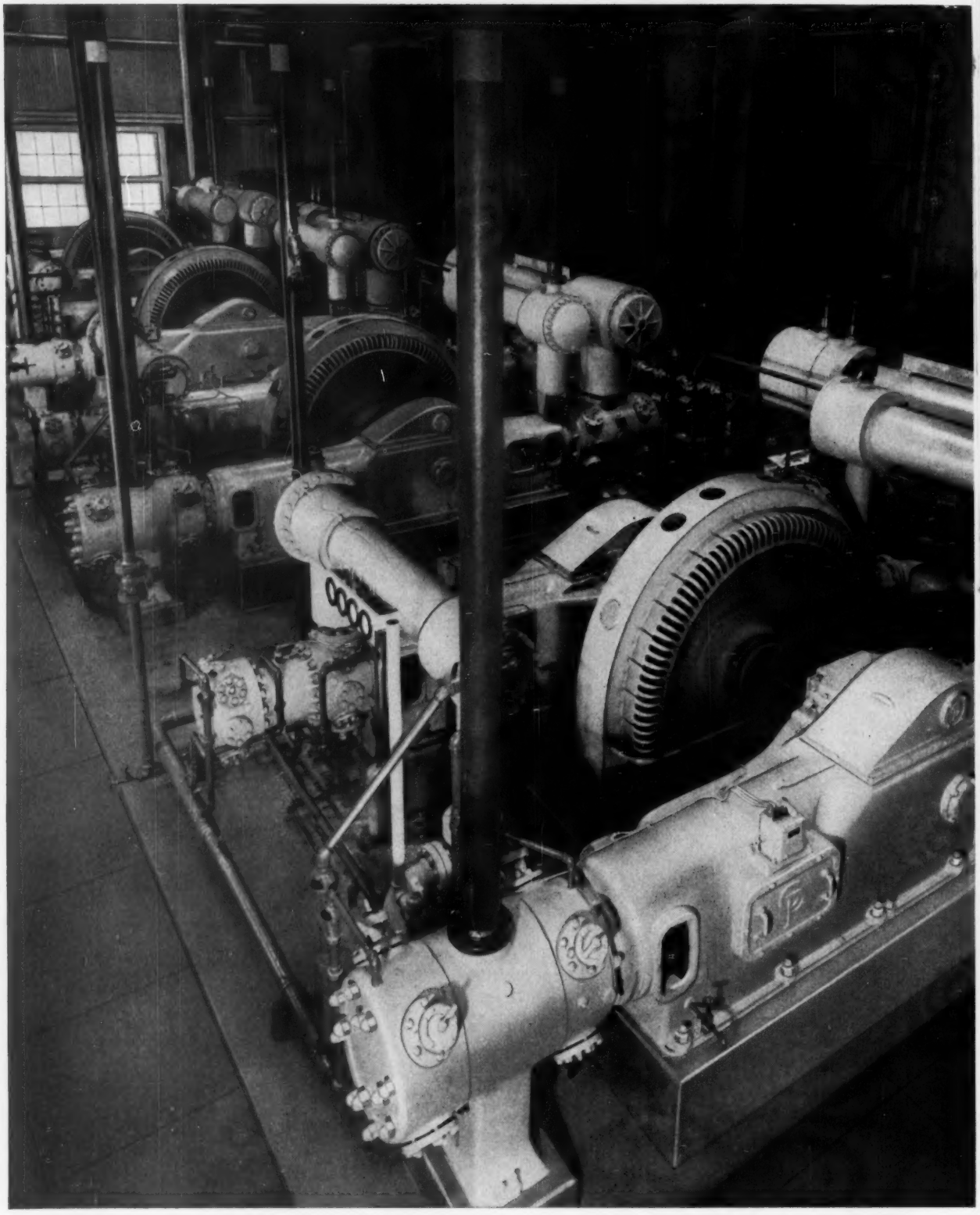
K&M

KIELEY & MUELLER, INC.

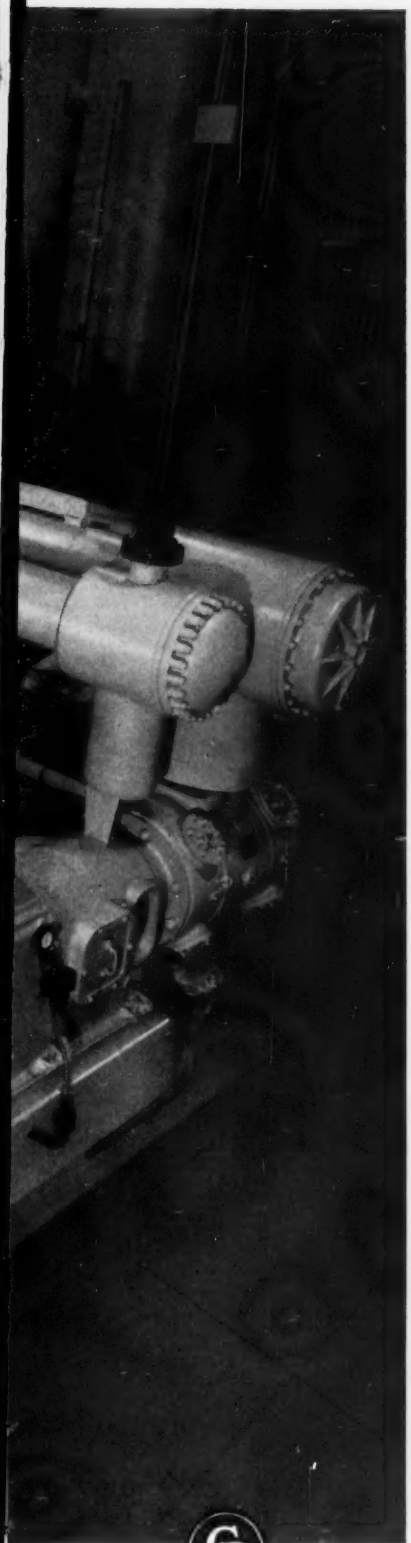
diaphragm control valves

Our 78th Year

Oldest Pressure and Level Control Valve Manufacturer
64 Genung Street, Middletown, New York



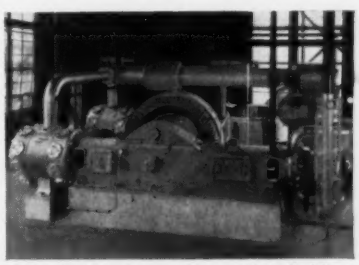
Four-stage Class H Compressors meet air liquefaction demands in a steel plant.



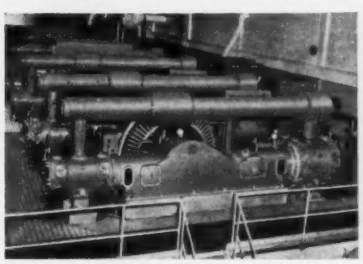
Low Speed FOUR-CORNER COMPRESSORS

- *maximum availability*
- *minimum attention*
- *greatest accessibility*
- *readily adapted to multi-staging*

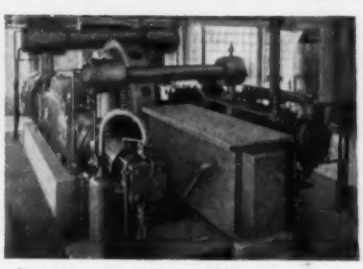
Chicago Pneumatic duplex, four-corner Class H Compressors afford optimum flexibility in arranging cylinders for one to six stages of compression, with correct distribution of load. These Class H Compressors, with motor or steam drive, are built in sizes to 2,000 horsepower for vacuum service or pressures to 15,000 psig. Other types available up to 5,000 horsepower.



Class H, three-stage compressor installed in a chemical plant.



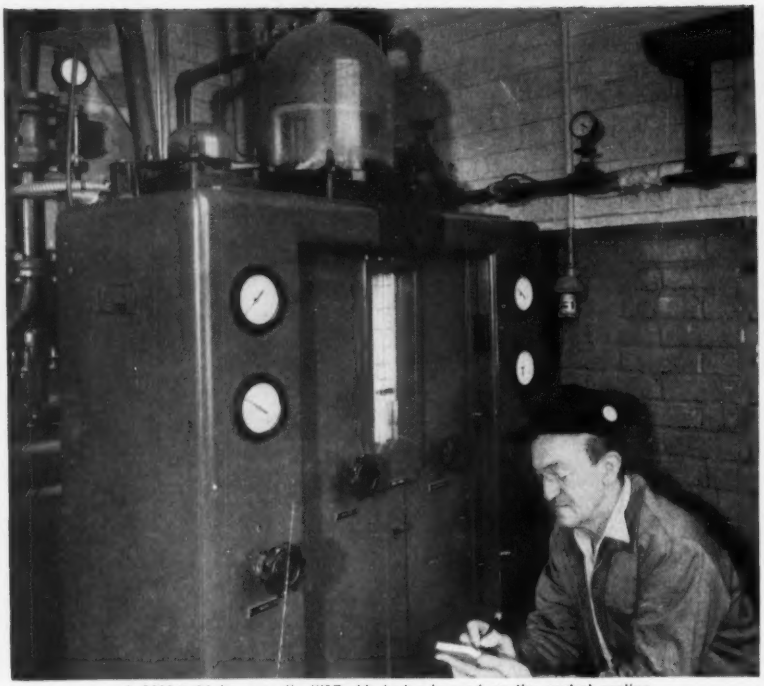
A pair of Class H, two-stage compressors supplies air in a West Coast installation.



Five-stage, four-corner 3,000 psig compressor in Japan — the first of three.

Chicago Pneumatic 8 East 44th Street, New York 17, N. Y.

AIR AND GAS COMPRESSORS • VACUUM PUMPS • PNEUMATIC TOOLS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS



A 6000#/24 hr. capacity W&T chlorinator is used on the central cooling water system at Marcus Hook, Penna. refinery of Sinclair Refining Company.

W & T CHLORINATION . . .

the economical way to prevent slime in cooling waters

Water used for cooling operations at the Marcus Hook refinery of Sinclair Refining Company is chlorinated to prevent slimes from fouling plant units and lowering cooling efficiency.

Chlorination of the system is accomplished by one W&T chlorinator operated from a program control panel. The control automatically starts and stops chlorination in accordance with a preselected schedule. Slime growths are eliminated in the cooling units without the need for continuous treatment.

For information about W&T chlorination for slime elimination write for Bulletin CD-43.

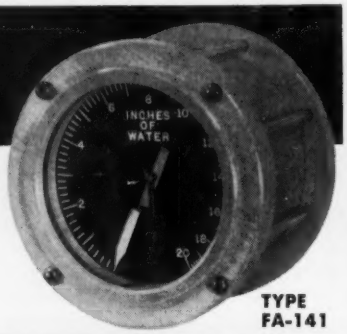
WALLACE & TIERNAN INCORPORATED

25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

PRECISE PRESSURE MEASUREMENT

. . . For Low Pressure Work

Ranges: 0—10 inches water (min.) to 0—30 inches mercury (max.). Intermediate ranges available.
Accuracy: 1/300 of full scale
Sensitivity: 1/500 in *all* ranges
Dial Size: 2¾" or 6" diameter



TYPE FA-141

Write for Publication No. TP-27-A

WALLACE & TIERNAN INCORPORATED

25 MAIN STREET, BELLEVILLE 9, N. J.

A 111

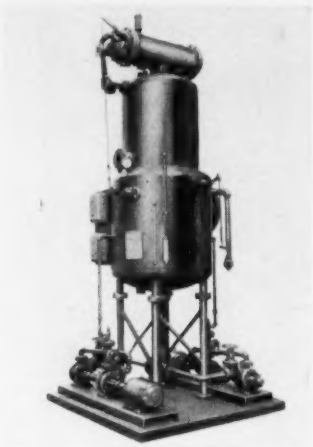
More EQUIPMENT NEWS

Begins on page 160

ger-tip adjustments without wrenches.

Units are available with manual or electric solenoid control, and with from 1 to 24 outlets, each with the new individual friction valve for feed control.

Trico Fuse Mfg Co, 2948 N 5th St, Milwaukee 12, Wis.



Feedwater heater unit

633 • Packaged unit consists of boiler-feed pumps and elevated heater mounted on a single base. Installation requires no engineering and hookup consists only of connecting three lines — feedwater inlet, steam inlet and outlet for feedwater to the boiler.

Unit is built in four sizes, with a capacity of 4500 to 19,500 lb of feedwater per hr, for boilers in the 200- to 600-hp range. Available with either single or duplex (illustrated) feed pumps. Operation is at 30 lb to provide feedwater temperature of 270 F. Request bulletin 117-A from the manufacturer for further information.

Stickle Steam Specialties Co, 2215 Valley Ave, Indianapolis 18, Ind.

For more details on these items, use post cards p 169. Identify your request with item number.

Large-bore clutches

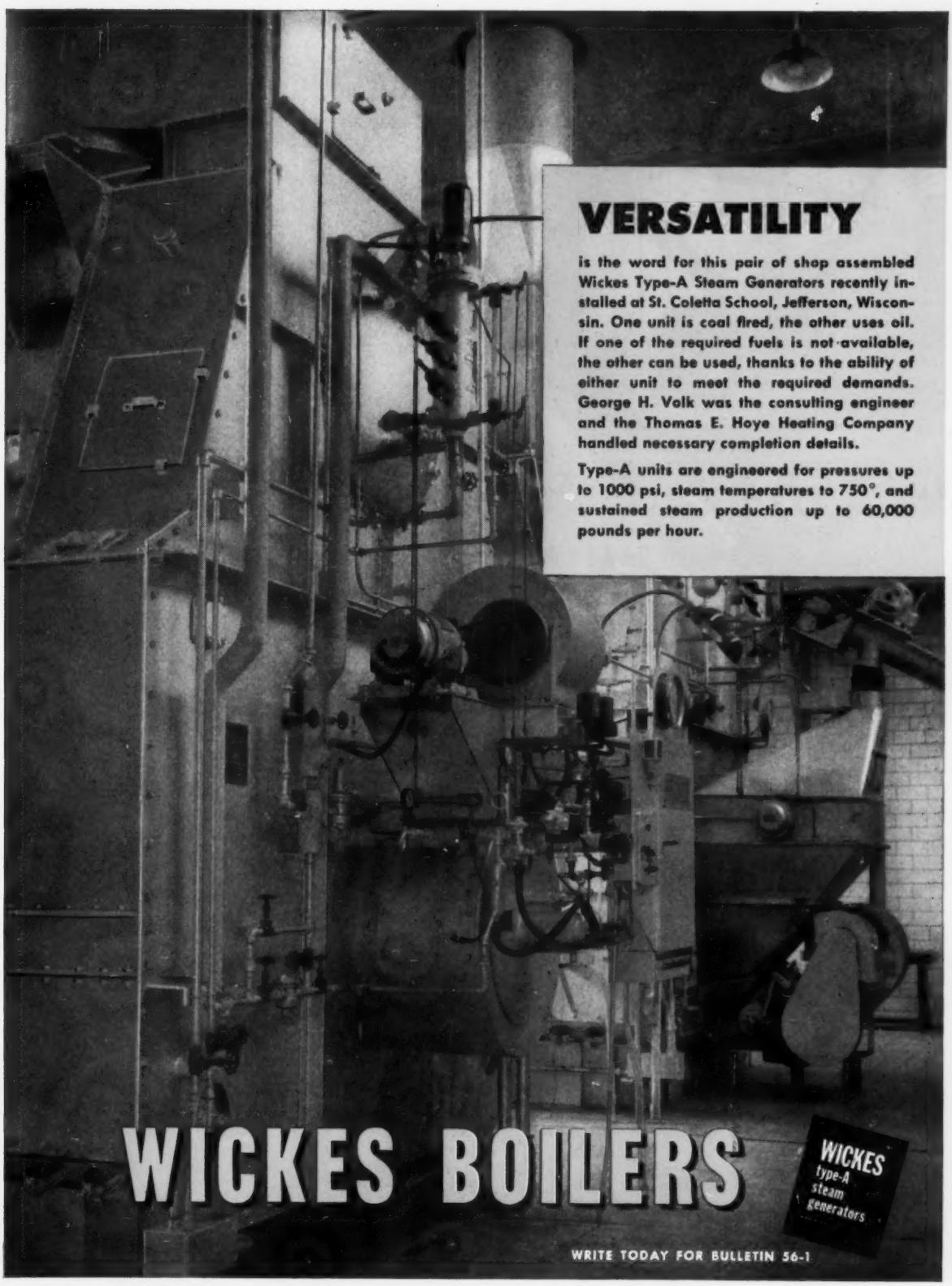
620 • Line of overrunning large-bore clutches is designed in six sizes for backstop purposes. They are normally installed on the headshafts of large conveyor systems. Other recommended applications are as dual drives for standby power applications and differential-speed drives.

The Formsprag Company 23601 Hoover Rd, Van Dyke, Mich.

Current-limiting fuses

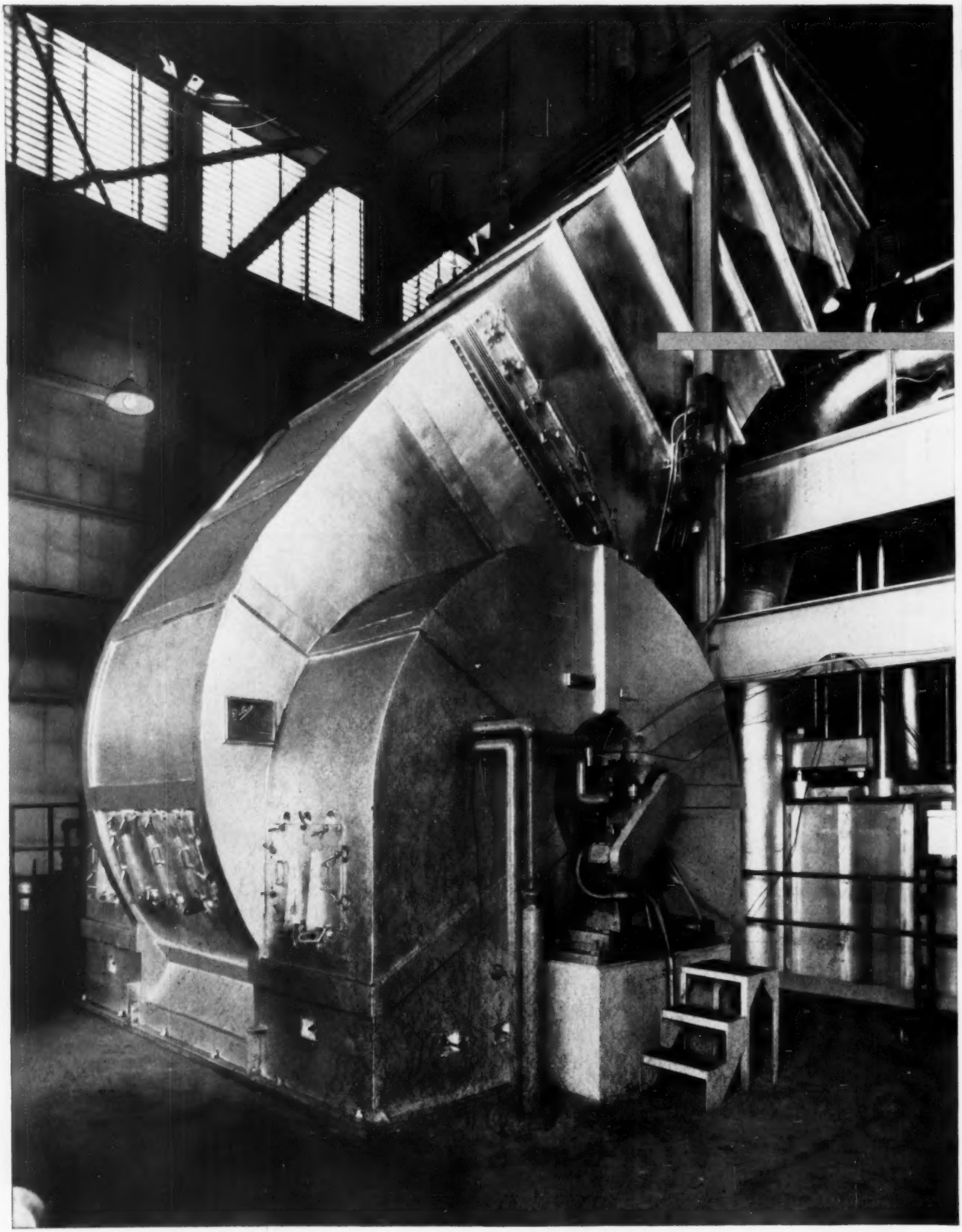
621 • These fuses have a testing interrupting capacity of 200,000 amps symmetrical. Designed to interrupt short-circuit currents in less than a quarter of a cycle, these

(*Continued on page* 200)


VERSATILITY
is the word for this pair of shop assembled Wickes Type-A Steam Generators recently installed at St. Coletta School, Jefferson, Wisconsin. One unit is coal fired, the other uses oil. If one of the required fuels is not available, the other can be used, thanks to the ability of either unit to meet the required demands. George H. Volk was the consulting engineer and the Thomas E. Hoye Heating Company handled necessary completion details.
Type-A units are engineered for pressures up to 1000 psi, steam temperatures to 750°, and sustained steam production up to 60,000 pounds per hour.
WICKES BOILERS
WICKES type-A steam generators
WRITE TODAY FOR BULLETIN 56-1

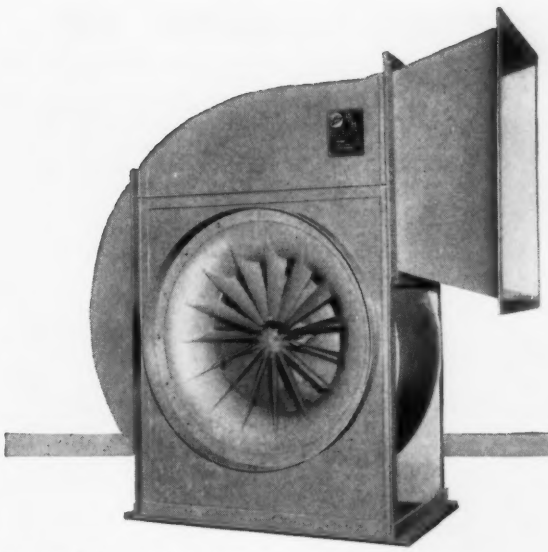
THE WICKES BOILER CO., DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

RECOGNIZED QUALITY SINCE 1854 • *SALES OFFICES:* Albuquerque, N. M. • Boston • Buffalo • Charlotte, N. C. • Chicago • Cleveland • Dallas Denver • Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Portland, Ore. • Saginaw Salt Lake City • San Francisco • Springfield, Ill. • Tulsa • Washington, D. C. 165

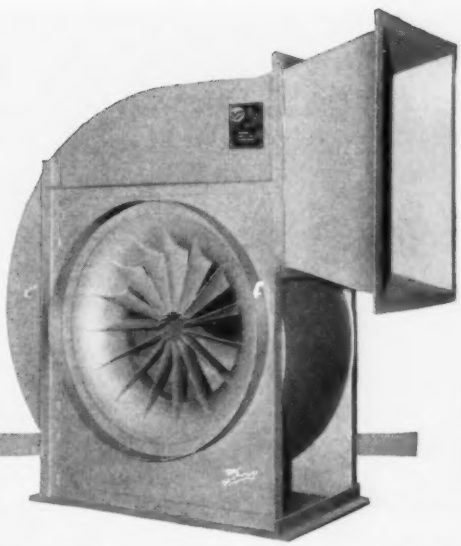


"BUFFALO" DOUBLE-WIDTH I.D. FAN *in station of one of the largest utility companies. Here, "Buffalo" backward-curve blade design provided the desired balance of high efficiency and long life over the range of boiler loads.*

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT



The "Buffalo" Type "BLH" Fan — broad performance characteristics — 86% mechanical efficiency.



The "Buffalo" Type "BA" Airfoil Fan — mechanical efficiencies up to 92%.

TO MATCH YOUR HORSEPOWER EVALUATION EXACTLY -

a complete series of "Buffalo" I.D. fans

Today's steam generation requirements are so varied and critical that no single type of mechanical draft fan can cover them all to best advantage. However, thanks to the complete "Buffalo" *series* of Fans, you can match fan characteristics to your requirements very closely.

Suppose maximum **efficiency at specific operating conditions is the major consideration.** The "Buffalo" Airfoil Fan, with mechanical efficiency up to 92%, would be the ideal choice, with 3 airfoil wheels and 3 semi-airfoil wheels available for best performance against the pressure of your particular system and load range. And dampered performance of the "Buffalo" Airfoil Fan is excellent, thanks to properly shaped and streamlined "Buffalo" Variable Inlet Vanes.

For systems where high efficiency over a broad operating range is of major importance, "Buffalo" Type "BLH" Fans offer stable performance and mechanical efficiency above 80% from 70% to 135% of rated volume. The "BLH" will operate at practically identical efficiency with either fixed or variable inlet vanes, for accurate volume without sacrificing fan performance.

Or where abrasive conditions exist, and where high-pressure, high-capacity characteristics could mean selection of a smaller (and lower-cost) fan, the "Buffalo" Type "CR" Radial Blade design merits your consideration. Besides inherent resistance to wear, it offers 76% static efficiency — plus a choice of three wheels for best performance under your pressures.

Write for Bulletins F-200, FD-205 and FD-106 for the one *complete* selection of Mechanical Draft Fans — "Buffalo" — known for the "Q" Factor, or *built-in Quality which provides trouble-free satisfaction and long life.*

BUFFALO FORGE COMPANY

BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

Panalarm Annunciator pinpoints process "off-normals"

In the process industries and among users of automatic machinery, trouble is minimized when it's caught early. That's the purpose of the Panalarm Annunciator System—a continuous monitor of your process.

One typical adaptation of the modular Panalarm system is engineered to differentiate between the first "off-normal" and subsequent "off-normals" caused by the first. This feature allows instantaneous recognition of the prime source of trouble in a "chain reaction."

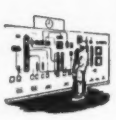
Another adaptation is designed specifically for motor start-up and shut-down. It has also been successfully adapted for supervisory control, pump control and programming.

Your Panalarm sales engineer will be happy to make a survey of your requirements to determine whether a Panalarm system can aid productivity and safety in your process. For electrical and mechanical data on standard systems, request Catalog 100B on your letterhead.

PANALARM

Division of
PANELLIT, INC.
7417 N. Hamlin Avenue, Skokie, Illinois
Panellit of Canada, Ltd., Toronto 14

Engineered Information Systems for Industry


Graphic Panels, Control Centers

Panalog Information Systems

Panellit Service Corporation

More EQUIPMENT NEWS

Begins on page 160

units protect branch feeders, lighting circuits, motor starters, control power circuits and similar applications where conventional fuses do not have sufficient interrupting capacity. Units are available in ratings from 6 to 4000 amps.

General Electric Co
Schenectady 5, N. Y.

Vibration-testing instrument

636 • Portable self-powered unit is designed to aid in setting up routine programs to seek out vibration and establish acceptable tolerances in production, inspection and maintenance. The 24-oz instrument is calibrated directly in three ranges of 0.1, 1 and 10 mils full-scale reading. It can be used in even the most inaccessible places, according to the manufacturer. Complete literature available on request to the manufacturer.

International Research & Development Corporation, 797 Thomas Lane Columbus, Ohio

For more details on these items, use post cards p 169. Identify your request with item number.

High-torque brakes

618 • Line of brakes combines high torque and fast cycling with the ability to hold or stop a load if power fails. These units are essentially two brakes in one. Four basic sizes are listed as standard with other sizes to be added as required. Power torque ratings range from 125 to 650 lb ft and fail-safe torque ratings from 33 to 205 lb ft. Models are also available that provide the fail-safe feature with electrical release but without power braking.

Warner Electric Brake & Clutch Co
Beloit, Wis.

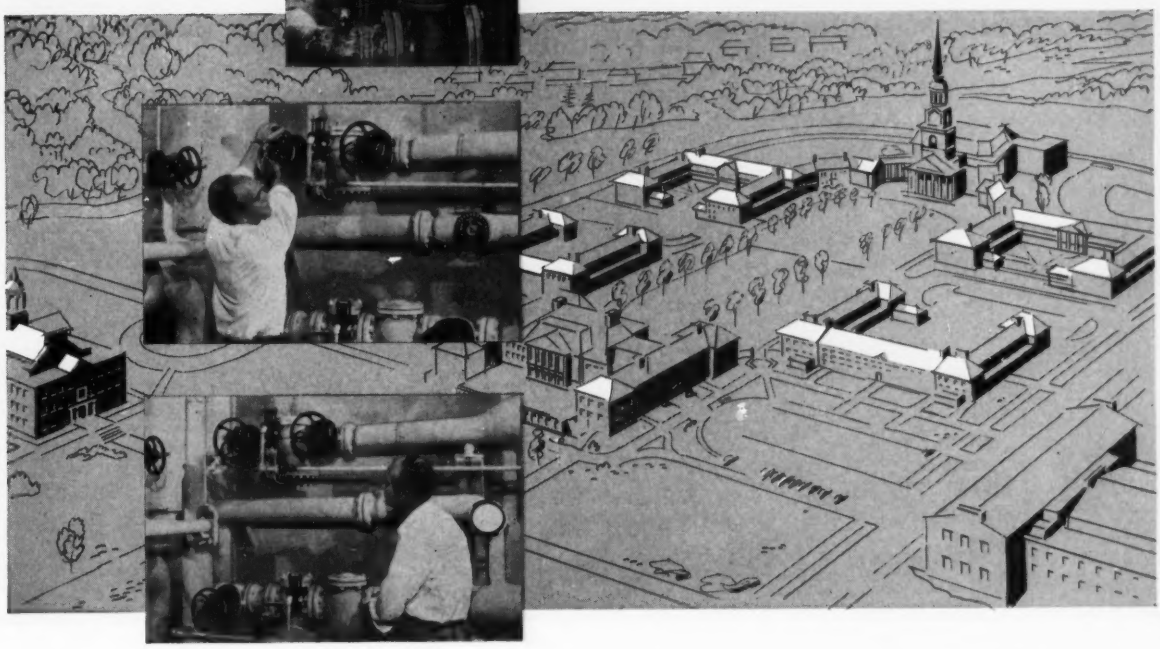
Step regulators

627 • Sixteen-step single-phase regulator has ratings up to and including 100 kva at 2500 and 5000 volts, 167 kva at 7620 volts, and 138 kva at 13.8 kv. Unit has a load range selector that enables selection of exact voltage regulation range to suit

(*Continued on page* 204)

A brand-new college

122 YEARS OLD



New Wake Forest College campus at Winston-Salem, North Carolina. In 27 of the new buildings OIC Valves have been used exclusively. According to H. S. Moore, Supt. of Buildings and Grounds, OIC Valves have never created maintenance problems for him in all his experience.

and you see OIC Valves everywhere!

Wake Forest College has been transplanted 110 miles from its original site to Winston-Salem, N. C. Its new campus consists of 28 sparkling, modified Georgian buildings, and everywhere you look everything is crisp and modern . . . from its beautifully designed quadrangle to its very last valve.

If you're ever close to Winston-Salem, visit Wake Forest College and enjoy this spectacle of modern design and construction techniques. You may see ideas you'll want to duplicate even down to the very last OIC Valve . . . the always modern, ever dependable, accepted valve line.

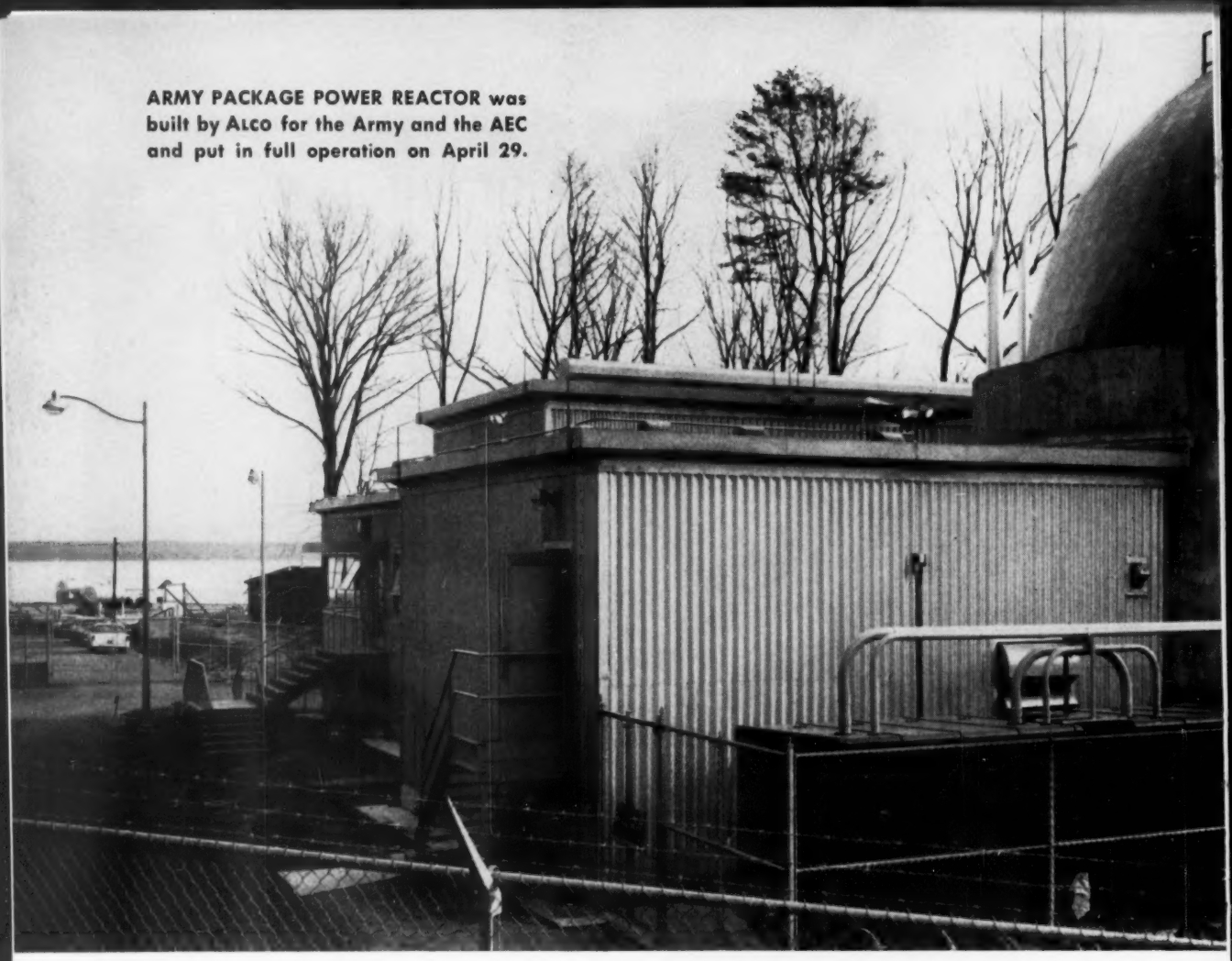
Architects: Larson & Larson, Winston-Salem, N. C.
Consulting Engineer: Louis Bouvier, Winston-Salem, N. C.
Materials Furnished by: Atlas Supply Co., Winston-Salem, N. C.

THE OHIO INJECTOR COMPANY
WADSWORTH • OHIO

OIC
FOUNDED 1893

VALVES

FORGED & CAST STEEL, BRONZE & IRON, LUBRICATED PLUG VALVES



ARMY PACKAGE POWER REACTOR was built by ALCO for the Army and the AEC and put in full operation on April 29.

NEW PWR POWER PLANT: POWER FROM

ALCO-built APPR in operation at Fort Belvoir, Va.; non-experimental plant first to generate useful power on land

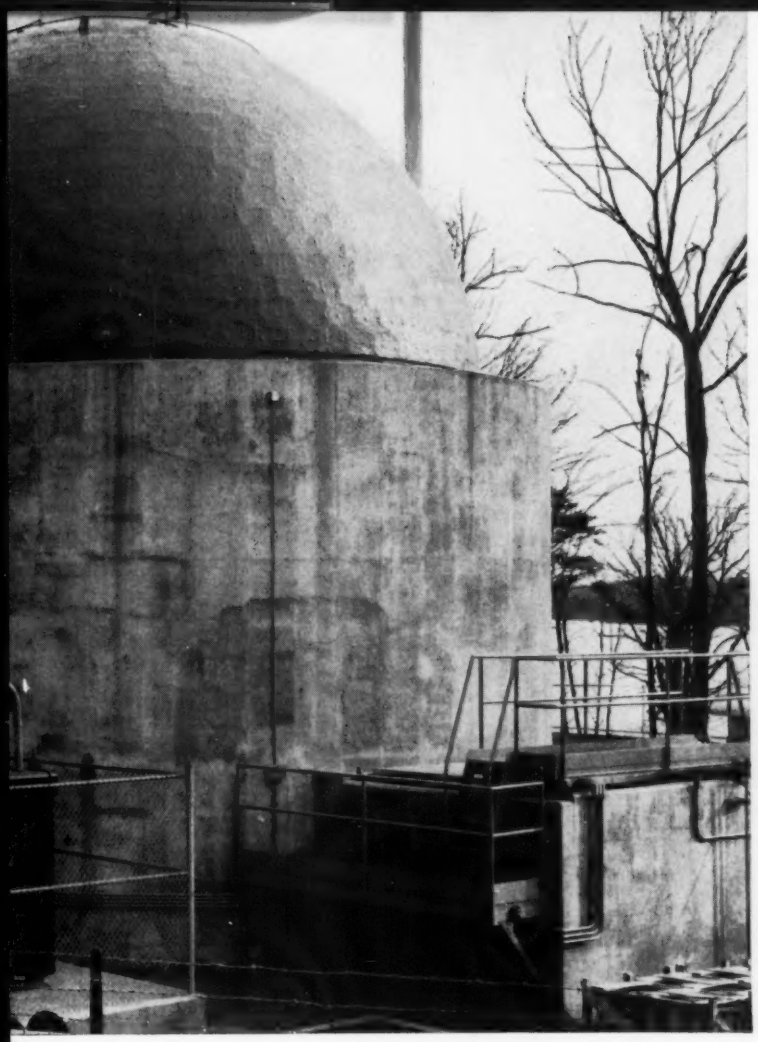
ALCO's Army Package Power Reactor, designed and built for the Army and the AEC, is now in operation at Fort Belvoir, Va., after dedication on April 29 by Army Secretary Brucker and AEC Chairman Strauss. Generating 2000 kw, it is the forerunner of a reactor family designed to provide economical power in areas where the costs of fossil fuels are high. Other PWR reactors, developed to 20,000 kw output from insights provided by the APPR, are now available from ALCO. Their hallmark: The invaluable experience gained by the builder of the first land-based reactor for power generation.

ALCO ATOMIC PLANTS NOT EXPERIMENTAL

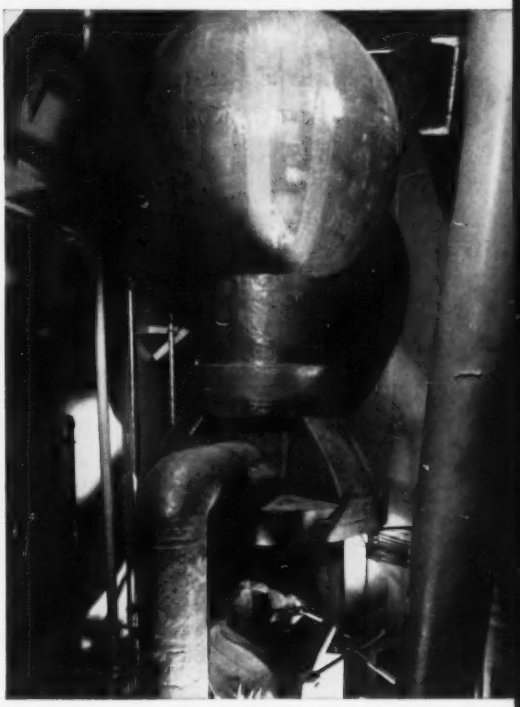
The ALCO PWR plants are not experimental. Their basic design concepts have been proved. In many areas of the U.S. their operation will be economically justifiable in just a few years—perhaps no later than the operation date of a reactor ordered today. ALCO will provide an evaluation of costs, studies of site factors and designs to help you. You may initiate action by writing, on your letterhead, to Atomic Projects, Dept. AE-2, P. O. Box 1065, Schenectady 1, New York.

ALCO NUCLEAR COMPONENTS ALSO PROVED

ALCO designed and built many of the components for the APPR, including the steam generator, pressurizer, feedwater heater and evaporator, control-rod drives and others. ALCO components are also included in the S1W, S2W, S3G, S4G, PWR, EBR and SRE systems. This extensive experience, plus facilities like complete thermal, mechanical and welding labs, and an electronic computer center, established ALCO as a

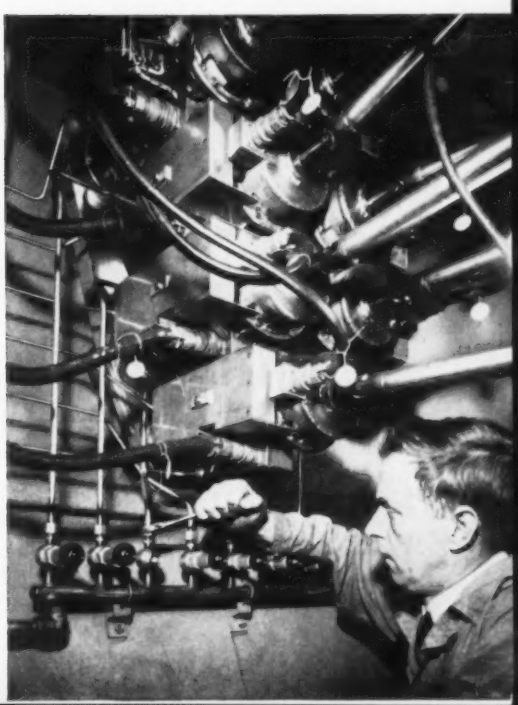


APPR PRESSURIZER was designed and built by ALCO, along with other components in primary loop. ALCO is leading nuclear component manufacturer.



THE ATOM NOW

APPR CONTROL ROD DRIVES, receiving final adjustment by ALCO technician in Fort Belvoir prior to operation, were designed and built by ALCO.



leading supplier of nuclear hardware. Here are some of the components available from ALCO:

- reactors
- reactor vessels
- control-rod drive mechanisms
- pressurizers
- steam generators
- core support structures
- core removal and handling equipment
- regenerative and non-regenerative exchangers
- liquid metal exchangers
- decay exchangers
- special heat-transfer equipment

ALCO

ALCO PRODUCTS, INC.

NEW YORK

Sales Offices in Principal Cities

AIRETOOL MEANS RESULTS

. . . results you can *measure* in lower operating costs, reduced down-time, greater efficiency and higher production. Plant engineers and maintenance chiefs the nation over *know* that installation, repair, removal and replacement of tubular equipment is completed faster, easier and at far less cost with Airetool Tube Maintenance Equipment. They know that Airetool Equipment handles easy, is rugged, packs plenty of power and speed, won't break down during use. There's no doubt about it . . . insist on AIRETOOL Equipment for your tube maintenance program. See your nearest Airetool Representative today . . . or write AIRETOOL MANUFACTURING COMPANY, Springfield, Ohio, for free illustrated literature and information.

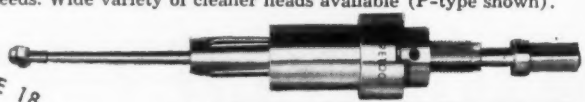
DESCRIBED ON PAGE 15

CONDENSER CLEANERS
Outside mounted, direct or gear driven. Powerful, fast, lightweight (11 lbs.). Cleans lightly scaled or completely plugged tubes to 1". Built in flushing system cools drill, removes chips.

MORE ON PAGE 5

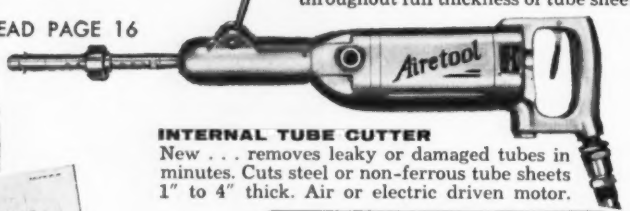
TUBE CLEANERS
Rugged, fast cutting, quickly and thoroughly removes hardest scale and deposit. Air driven motors in wide range of sizes and speeds. Wide variety of cleaner heads available (P-type shown).

SEE PAGE 18



CONDENSER TUBE EXPANDERS
Parallel rolling—self feeding—Airetool Tube Expanders roll right, accurate tube joints with maximum bond, uniform expansion and tightness throughout full thickness of tube sheet.

READ PAGE 16



INTERNAL TUBE CUTTER
New . . . removes leaky or damaged tubes in minutes. Cuts steel or non-ferrous tube sheets 1" to 4" thick. Air or electric driven motor.

Write for illustrated Airetool Bulletin No. 60, showing complete line of Airetool Tube Maintenance equipment plus Airetool Specialty tools . . . Airetool's new, light-weight, air-motor grinders . . . and Airetool's Automatic Expansion Control System.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

BRANCH OFFICES: New York, Chicago, Tulsa, Philadelphia, Houston, Baton Rouge
REPRESENTATIVES in principal cities of U. S. A., Canada, Mexico, South America, England, Europe, Puerto Rico, Japan, Hawaii.
EUROPEAN PLANT: Vlaardingen, The Netherlands
CANADIAN PLANT: 37 Spalding Drive, Brantford, Ontario

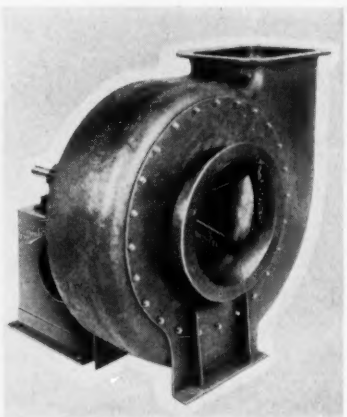
More EQUIPMENT NEWS

Begins on page 160

the load current of the feeder being regulated.

Routine cleaning and maintenance of core and coils is eliminated. A separate tap changer compartment keeps contaminating products formed during tap change out of core and coil.

Westinghouse Electric Corp
PO Box 2099, Pittsburgh, Pa.



Corrosion-resistant fans

632 • Resin-bonded fiber-glass fume fan is designed for the most severe corrosive air-handling jobs. Manufacturer claims they afford excellent chemical resistance to a wide variety of acids, salts, gases, organic materials and other corrosives in temperature applications to 225 F.

Fiber-glass fan housing has integral stainless-steel studs molded-in for attachment to bearing stand. Thus covered, the studs are protected from contact with air stream. Rotor is carefully balanced with all exposed parts encased in thick fiber glass. Units are available in standard capacities to 34,000 cfm at pressures to 10-in. static. Request bulletin FI-511 from the manufacturer for further information.

Buffalo Forge Company
490 Broadway, Buffalo, N. Y.

For more details on these items, use post cards p 169. Identify your request with item number.

Quality-control instrument

626 • Nondestructive tester can, according to manufacturer, be used for a high rate of production testing. Unit is portable and can be plugged into any 110-volt outlet in a plant. No special training is needed to operate it.

Instrument consists of a small metal cabinet containing electronic equipment and a probing coil connected by coaxial cable with the cabinet. The probing coil is used to contact the part under test—such as a bearing, a rod or a piston pin—and it can be designed for probing parts of virtually any shape.

General Motors Corp
1775 Broadway, New York 19, N. Y.

World's First Supercritical Double-Reheat Steam Turbine Installed at Philo Plant

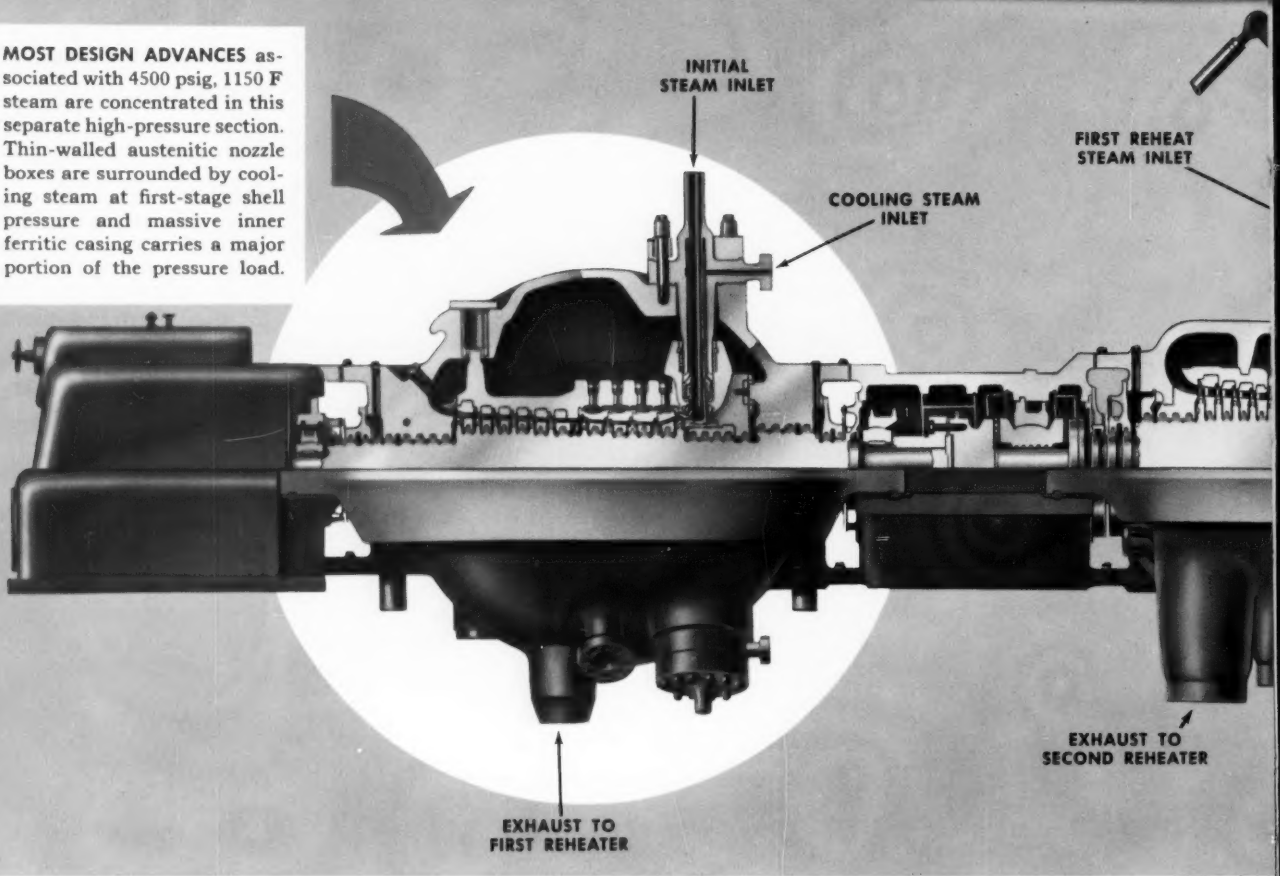
New 125,000-kw General Electric unit at Philo Plant of Ohio Power Company marks another milestone of progress in the development of more economical electric power production through higher initial steam conditions.

Progress Is Our Most Important Product

GENERAL ELECTRIC

FOR DETAILS, TURN TO NEXT THREE PAGES

MOST DESIGN ADVANCES associated with 4500 psig, 1150 F steam are concentrated in this separate high-pressure section. Thin-walled austenitic nozzle boxes are surrounded by cooling steam at first-stage shell pressure and massive inner ferritic casing carries a major portion of the pressure load.



Higher pressures and temperatures operate through double-reheat cycle to raise fuel economy

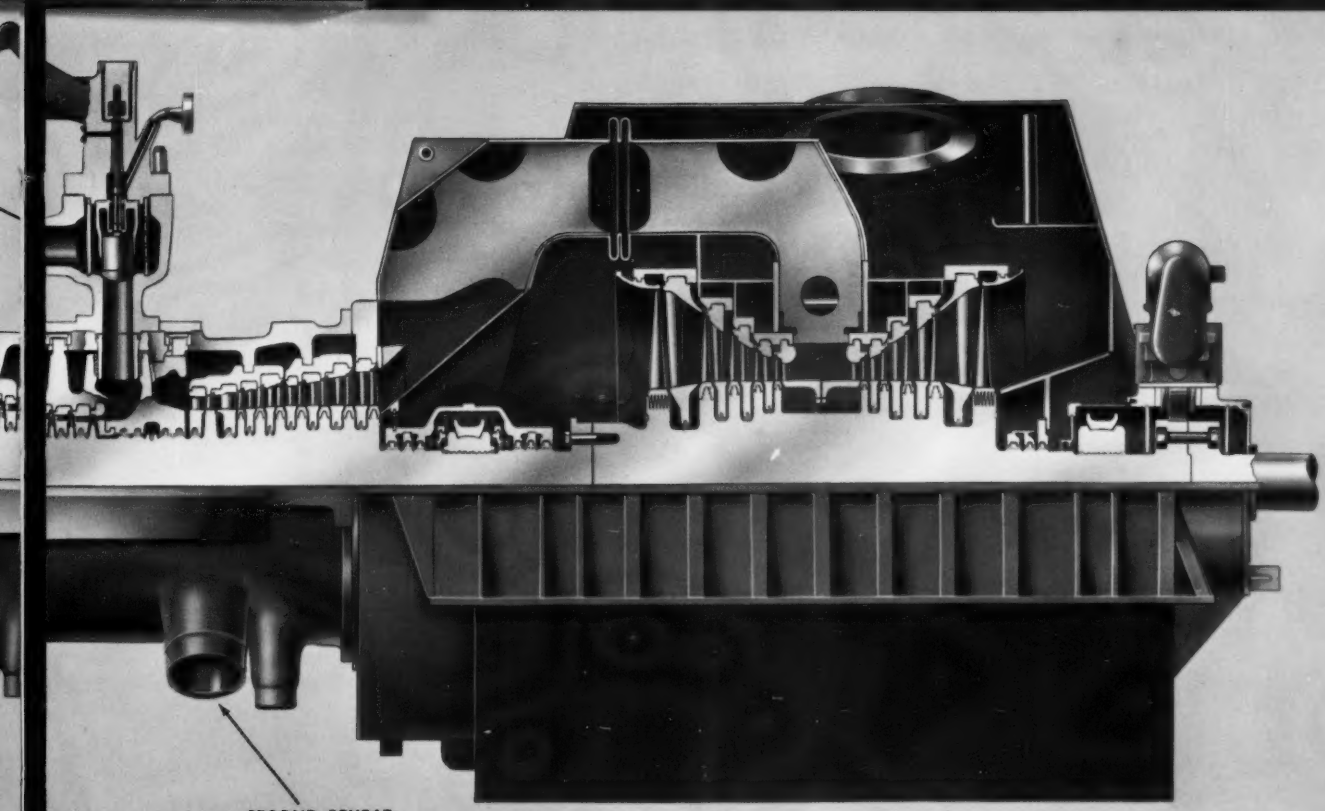
New unit will run at 4500 psig, 1150 F initial temperature, with 1050 F first reheat and 1000 F second reheat

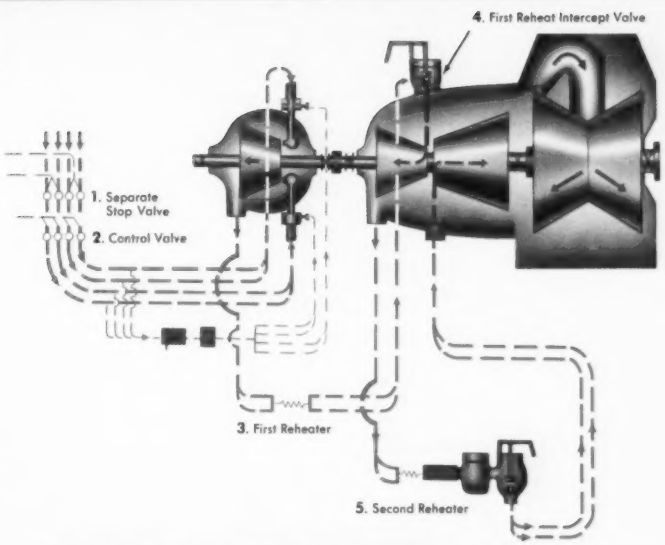
The Ohio Power Company's Philo Plant, one of the key generating units of the American Gas & Electric Company's system, has become the site of another significant advance in electric power generation. It will be the first station to generate commercial electric power from a turbine-generator operating at the supercritical pressure of 4500 psig—almost double the highest pressure used to date. Its initial steam temperature of 1150 F is 50° greater than the previous high of 1100 F reached only three years ago.

These advanced steam conditions, coupled with the first application of the double reheat cycle, can increase thermal efficiency 5% over the most efficient steam plant now in operation.

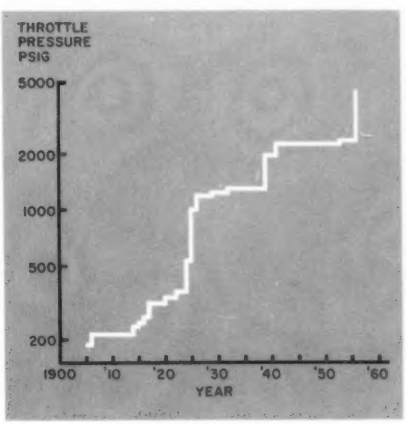
ONE OF THE MAJOR PROBLEMS General Electric designers had to overcome was the danger of thermal distortion of thick austenitic castings and forgings. So austenitic steel parts were made as thin as possible by use of 1) a steam cooling arrangement which permits the use of thin-walled austenitic sections with low temperature gradients and reduced susceptibility to distortion, 2) individual control valve bodies of small diameter and consequently thinner walls, 3) multiple steam pipes with individual turbine stop valves placed in each line, and 4) simple throttling control with full 360-degree arc admission to the first stage nozzles.

THE EXPERIENCE GAINED and new ideas developed during the design and manufacture of this first supercritical-pressure steam turbine are already being applied to the study of larger units for even more economical operation. The Philo turbine may well mark a turning point in the history of steam power generation. For more details, write for Bulletin GER-1130, Large Steam Turbine-Generator Department, General Electric Co., Schenectady 5, New York.





Progress in increasing throttle steam pressure over the past 50 years. The new advance to 4500 psig represents the first major step upwards since a maximum of 2300 psig was achieved in the early 1940's.



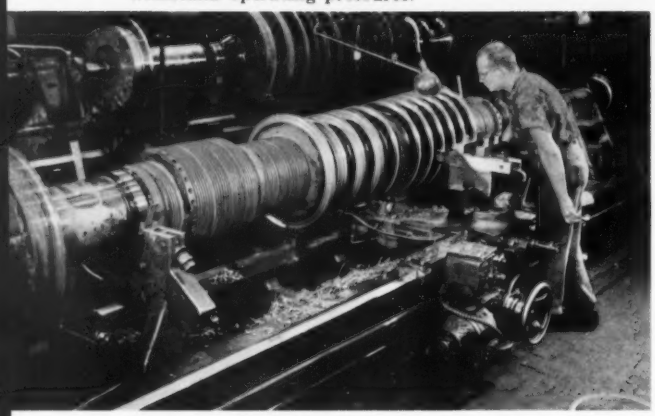
SUPERCRITICAL STEAM ENTERS THE TURBINE through four main steam pipes. Each pipe has a separate stop valve (**1**) and control valve (**2**) located below the turbine room floor. Steam exhausts at 800 F to first reheater (**3**). Here it is reheated to 1050 F and enters center of intermediate turbine through first intercept reheat valve (**4**). Then it expands through nine stages toward middle standard and exhausts to second reheater (**5**) at approximately 207 psig, 600 F. Steam leaves reheater at 1000 F to re-enter remaining portion of intermediate section, passes through crossover, and expands to condenser through double-flow, low pressure turbine.

GENERAL ELECTRIC

Building a 4500 psig supercritical steam turbine...

1 **CASTING COMES IN:** Lower half of massive cast ferritic outer casing for high-pressure section is delivered. Spherical shape helps minimize stress and enables casing to withstand operating pressures.

2 **MACHINING OF CASTING** is done with extreme accuracy. Prior to machining, casting was thoroughly checked for internal flaws by 15-million-volt betatron, which can "see" through more than a foot of steel.



3 **ROTOR IS MACHINED** from a solid forging of Type 347 steel, then heat treated to remove stresses. An alternate steam-cooled ferritic rotor is also being supplied for further developmental studies.

4 **ROTOR IS INSPECTED** after final assembly. First stage buckets are only about $\frac{3}{8}$ in. long, with multiple-hook dovetails designed to take care of differences in thermal expansion between rotor and buckets.

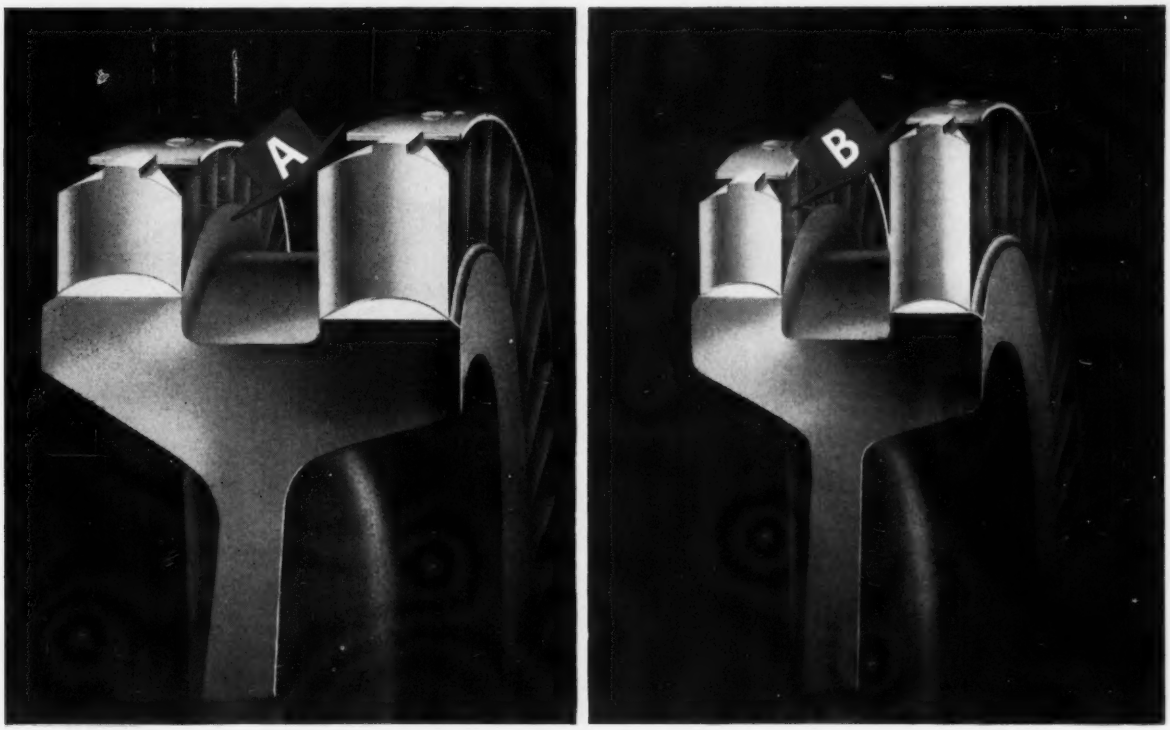
5 **TURBINE IS ASSEMBLED** as high-pressure rotor is lowered into lower half of shell. High temperatures and pressures necessitated several unique innovations in design of diaphragms and other parts.

6 **FINAL ASSEMBLY** is culmination of months of designing, manufacture and exhaustive testing of individual components. Operating at 4500 psig, this unit will help evaluate the use of supercritical steam.

254-32

Leader in Turbine-Generator Progress

GENERAL ELECTRIC



(Left, A) wide bucket "L" type wheel. (Right, B) regular type wheel for Coppus Steam Turbines

Now . . . for low steam consumption – **COPPUS TURBINES** *can be furnished with wide bucket "L" type wheel*

Good news for steam turbine users where low steam consumption is important!

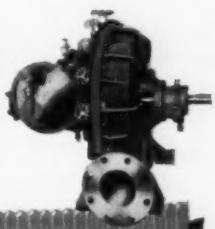
The Coppus Type "L" Wheel is the answer to this problem. Larger turbine buckets are employed to make the most economical use of steam.

In every respect the Coppus Turbine offers the top-quality features and advantages that have made the Coppus line outstanding for efficiency and economy. For example:

- Turbines rated close to your exact hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther.* Send for Bulletin 135 on Coppus Turbine.

COPPUS ENGINEERING CORPORATION
166 Park Avenue
Worcester 2, Mass.
Sales offices in
THOMAS' REGISTER



COPPUS "BLUE RIBBON" TURBINES

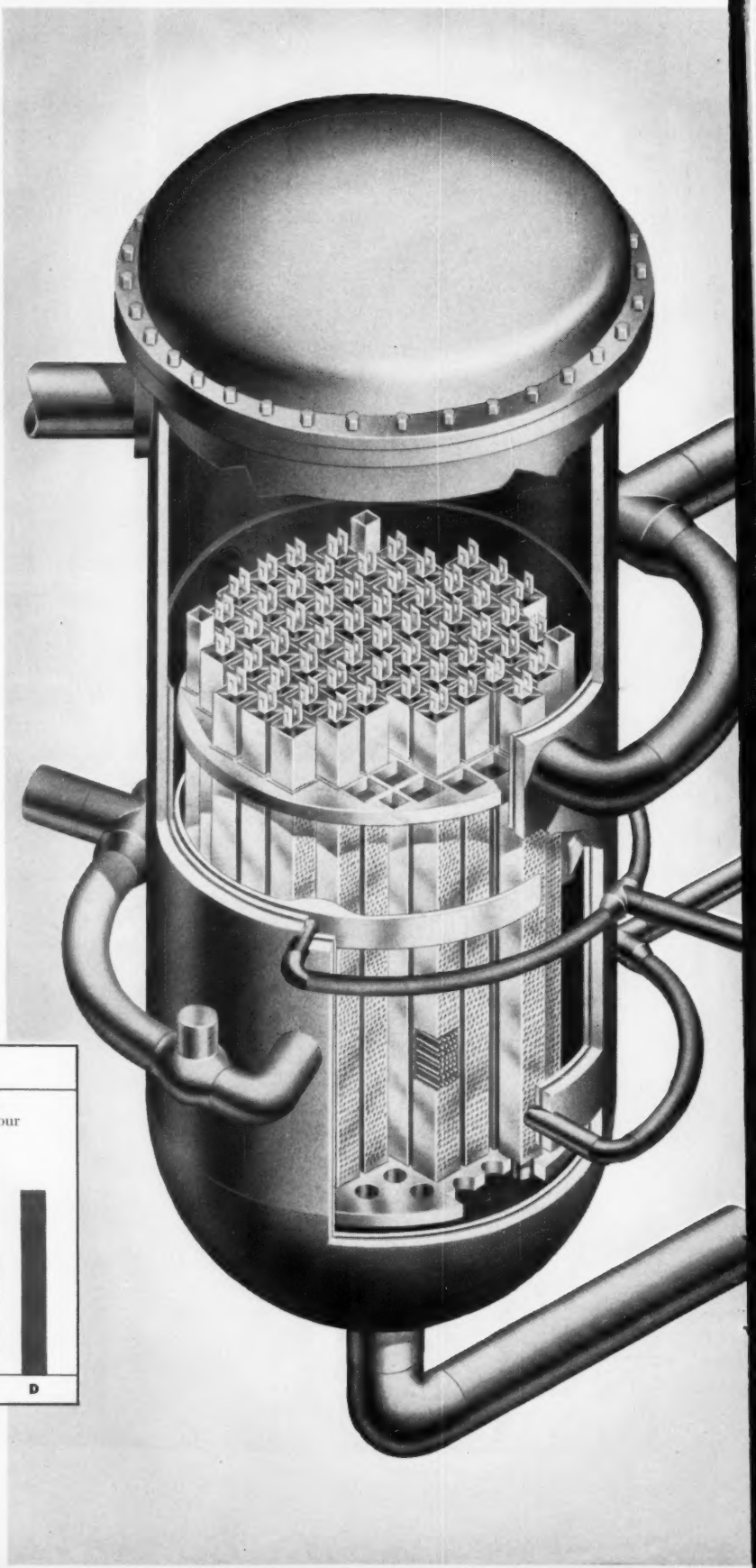
AMERICAN-Standard VMR DESIGN

*A new commercially applicable nuclear-fueled boiler**

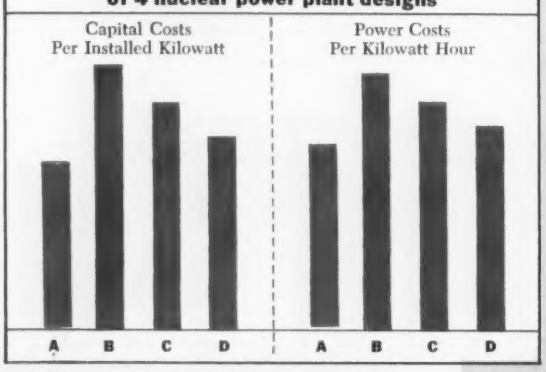
The American-Standard Variable Moderator Reactor (VMR) is a significant step forward in nuclear power plant design. Because of its simplicity it has been aptly termed a nuclear-fueled boiler. The VMR is a logical extension of the most promising reactor types, and eliminates many of their costly features. The design not only does away with the need for control rods and attendant position indicating devices, but more important, embodies a fuel reserve for prolonged reactor operation. Among the many advantages of this new reactor are:

- Lower power generation cost
- Lower capital outlay
- Simple, reliable operation
- Inherent safety
- Maximum on-line time

** Patents applied for.*



COST COMPARISONS
of 4 nuclear power plant designs



PLANT A—American-Standard nuclear-fueled boiler
PLANT B—Pressurized-water reactor #1
PLANT C—Pressurized-water reactor #2
PLANT D—Boiling water reactor

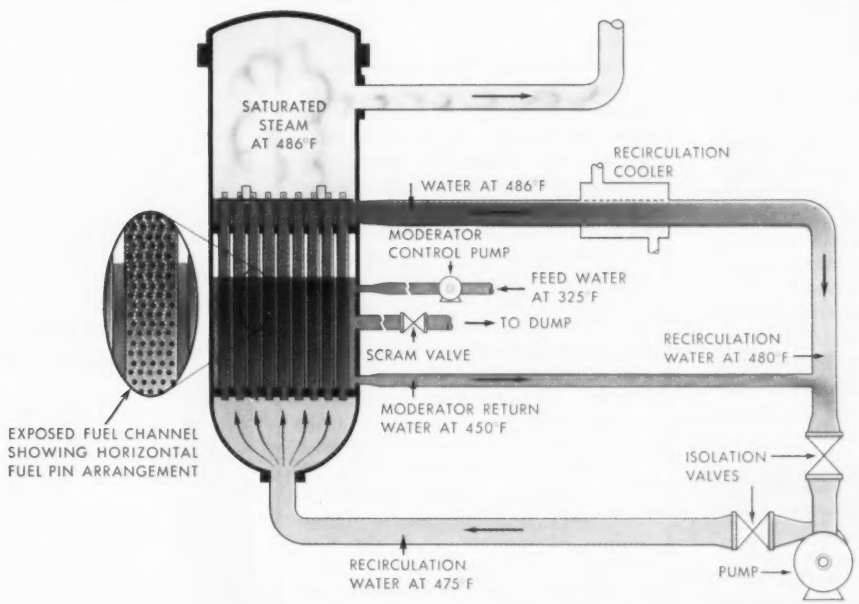
FOR LOWER COST NUCLEAR POWER

Unique principle of operation

The American-Standard nuclear-fueled boiler employs a variable moderator level for control, with heat generation accomplished in a coolant recirculation system.

Here is how the nuclear-fueled boiler functions: Condensate return is heated in several feedwater heaters and introduced into the reactor vessel in the moderator region. The feedwater enters the reactor at a rate sufficient to maintain the moderator level necessary for reactor operation at the desired condition of plant operation. The moderator flows from the upper portion of the core down the outside of the fuel elements into the recirculation line and mixes with recirculated coolant. Steam is produced as the coolant is forced upward through the fuel channels, which are of a horizontal pin (cross-flow) design affording high heat transfer characteristics and simple fabrication. A mixture of steam and water is ejected from the upper end of the fuel channels. The steam is taken out to a steam separator through a separately fired superheater and on to the turbine. The water emerging from the top of the fuel channels is returned through the recirculation line for another pass through the core. A steam by-pass line is provided around the turbine to damp out oscillations in the reactor power level as required. Scram is accomplished by flashing a portion of the moderator into a dump tank.

The nuclear-fueled boiler combines variable moderator control with conventional steam power plant design practices to produce a unit suited to a wide range of power requirements.



AMERICAN-Standard

ATOMIC ENERGY DIVISION

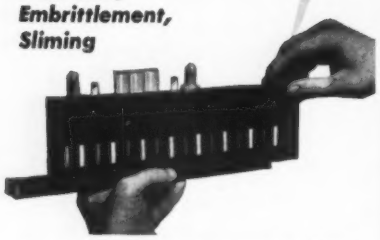
REDWOOD CITY • CALIFORNIA

fast, accurate tests for pH, PHOSPHATE, NITRATE

with

TAYLOR COMPARATORS

Help Control Scaling, Corrosion, Embrittlement, Sliming



In a matter of minutes, you can have accurate determinations of pH, phosphate, nitrate or silica content by making on-the-spot colorimetric tests with lightweight, portable Taylor Comparators. No technical knowledge or experience is required to get dependable operational data. Testing consists of comparing the treated sample with the movable color standard slide until colors match. You then read values direct from slide. All Taylor sets come complete with necessary accessories, reagents and instructions. Complete water analysis is only a little more detailed with the Taylor Water Analyzer.

To determine water hardness quickly, yet with the ease and accuracy of an alkalinity titration, use the Taylor Total Hardness Set.

COLOR STANDARDS GUARANTEED.

Be sure to use only Taylor reagents and accessories with Taylor Comparators to assure accurate results. All Taylor liquid color standards carry an unlimited guarantee against fading.

SEE YOUR DEALER for Taylor sets or immediate replacement of supplies. Write direct for FREE HANDBOOK, "Modern pH and Chlorine Control". Gives theory and application of pH control. Illustrates and describes full Taylor line.

W. A. TAYLOR AND CO.
YORK RD. & STEVENSON LANE • BALTO.-4, MD.

COOLING TOWERS

Continued from page 89

instead of sulfuric acid to control tower water pH. Sulfur is burned to SO_2 in simple pots and the gas is carried into the tower along with entering air. There it combines with water to form H_2SO_3 and is soon oxidized to H_2SO_4. It reacts with carbonates in the water as described above.

Using sulfur is safer and more economical than acid, but it is less automatic and cannot be controlled so closely. The burner pots are operated manually as long as needed to get pH down to the desired level. Since chlorine may be used up rapidly in oxidizing H_2SO_3 and H_2SO_4, sulfur burners are usually shut off during chlorine feed periods.

The sulfite radical present from sulfur burning and before oxidation to the sulfate radical may affect tower wood adversely. Sulfite solutions are quite effective in delignification processes in pulp and paper making. But this possibility has not yet been definitely proved in cases of tower deterioration.

Sulfur burners and ducts carrying SO_2 into the tower may have short life unless they are made of corrosion-resisting material.

Algae growth. When a new tower is put into service, algae growth is negligible for a month or two while the toxic material in the wood is being leached out. After the excess toxic material is dissipated and that leached out has been lost from the tower water by blowdown, algae growth may begin. Probably the most effective way to control it is by feeding free chlorine.

Chlorine is usually received in liquid form, under pressure. Reducing pressure converts it to gas which rapidly combines with water to form a chlorine solution. The solution is fed into the condensing water system, usually at the tower outlet or circulating-pump inlet.

Different types of algae require different treatment. Feeding chlorine intermittently is usually as effective as feeding continuously. It is also more economical. Nearly all forms of algae are killed by exposure to one or two ppm of free chlorine.

Amount fed must be somewhat larger than this, however, to satisfy requirements of reaction with chemicals and organic material in the water and on the conduit sides or tower surfaces.

Chlorine is rapidly aerated from the water as it passes over the cooling tower. So the amount in solution is lost within a few minutes after feed is stopped. Intervals between chlorine feed periods may be from one to 20 hours or longer; length of feed period

(*Continued on page 216*)

Jerguson Boiler Water Gages give Maximum Visibility, with no blind spots, within the boiler centers available. Special OS&Y valves with horizontal loop keep strain off gage under expansion and contraction conditions; compact design takes less space. Unique gage design with one-piece chamber and staggered glasses and covers eliminates blind spots. You get more gage in the space; more visible glass in the gage.

Gage can be turned at any angle, yet it has no stuffing boxes between gage and valves. Ten standard assemblies, WSP of 650, 900 and 1500 lbs. Visible glass to 18".

Accurate Level at Operating Floor, too!

Jerguson Truscale Gage with the New Convex Scale gives full 180° visibility . . . brings your liquid level reading down to your operating floor. Can read level from anywhere in the room. Sensitive to ½ of 1% of scale reading. Meets boiler code for 900 psi or higher. Available with lights, horns and repeaters.

Send for complete data on New Jerguson Boiler Water Gages . . . and Convex Scale Truscales.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Adams Street, Burlington, Mass.
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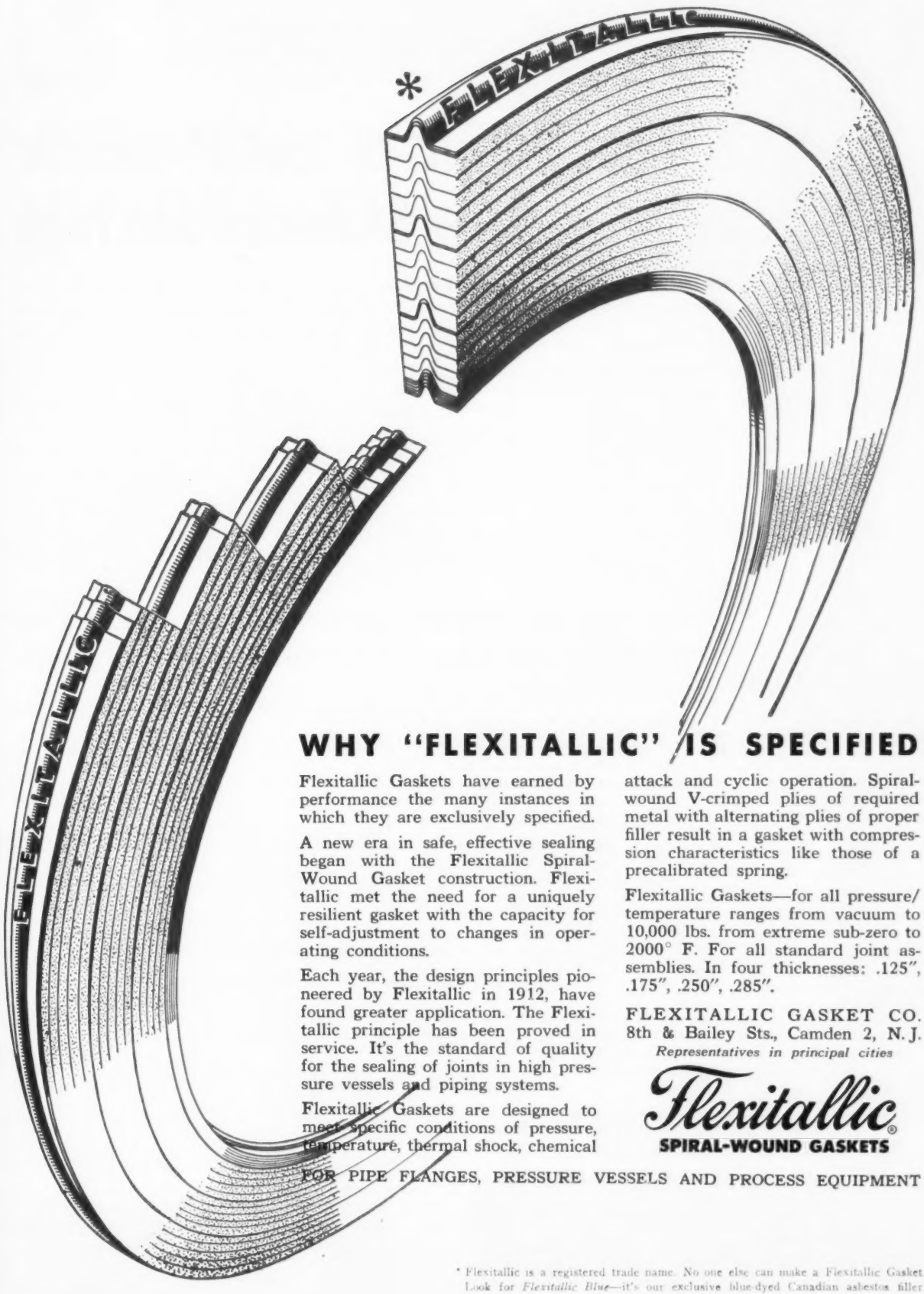


WHY "FLEXITALLIC" IS SPECIFIED

Flexitallic Gaskets have earned by performance the many instances in which they are exclusively specified.

A new era in safe, effective sealing began with the Flexitallic Spiral-Wound Gasket construction. Flexitallic met the need for a uniquely resilient gasket with the capacity for self-adjustment to changes in operating conditions.

Each year, the design principles pioneered by Flexitallic in 1912, have found greater application. The Flexitallic principle has been proved in service. It's the standard of quality for the sealing of joints in high pressure vessels and piping systems.

Flexitallic Gaskets are designed to meet specific conditions of pressure, temperature, thermal shock, chemical attack and cyclic operation. Spiral-wound V-crimped plies of required metal with alternating plies of proper filler result in a gasket with compression characteristics like those of a precalibrated spring.

Flexitallic Gaskets—for all pressure/temperature ranges from vacuum to 10,000 lbs. from extreme sub-zero to 2000° F. For all standard joint assemblies. In four thicknesses: .125", .175", .250", .285".

FLEXITALLIC GASKET CO.
8th & Bailey Sts., Camden 2, N. J.
Representatives in principal cities

Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

* Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue*—it's our exclusive blue-dyed Canadian asbestos filler.

You get millions of feet of nuclear with *Carpenter* Stainless and High

● Carpenter's role in harnessing the atom, first for wartime use and later for national defense and peacetime uses, began during World War II. For nearly 15 years, Carpenter has cooperated with the AEC and prime contractors on many of the nation's top nuclear energy projects, supplying millions of feet of stainless and high alloy tubing and pipe for these installations.

Carpenter's leading role in the nuclear energy field is shown by the following applications: Carpenter supplied stainless tubing and pipe for Hanford Works' first production facility; the first finned tubing used by the AEC at Hanford Works; 100 miles of tubing supplied for the Dana Project; square-shaped tubing to Argonne National Laboratory for a boiling water reactor; and many more.

Significant Carpenter developments include the first successful use of welding to produce stainless and special alloy tubing and pipe . . . the origination of Schedule 5 pipe . . . super corrosion-resistant Stainless No. 20Cb . . . titanium tubing and pipe . . . long lengths of Alloys B and C . . . and stress corrosion-resistant 7Mo Stainless Tubing and Pipe.

More than 30 analyses of tubing and pipe can be and have been supplied for nuclear energy plants

Carpenter experience in producing millions of feet of tubing and pipe for nuclear energy requirements embraces these standard stainless analyses and specialty high alloys:

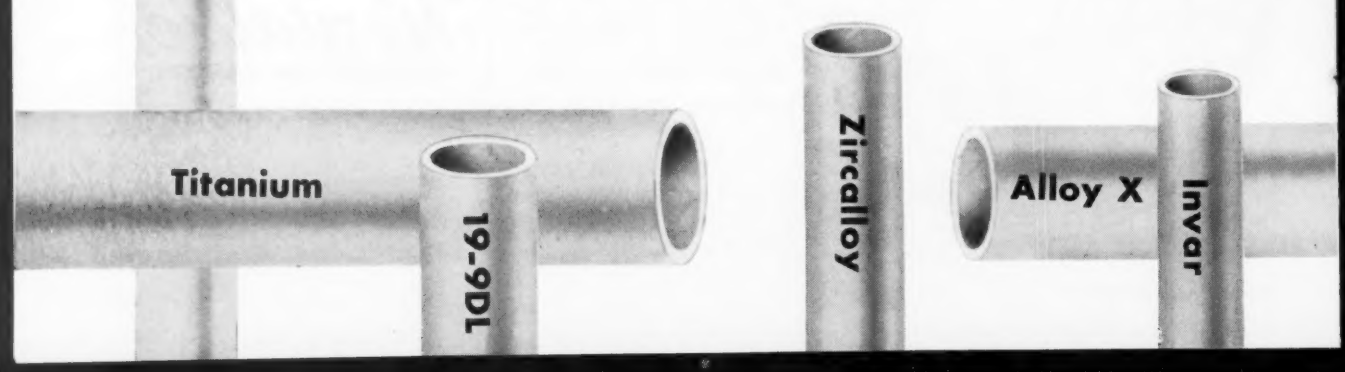
304	310	317L	348
304L	316	318	430
309	316L	321	442
309S	317	347	443
309S-Cb			

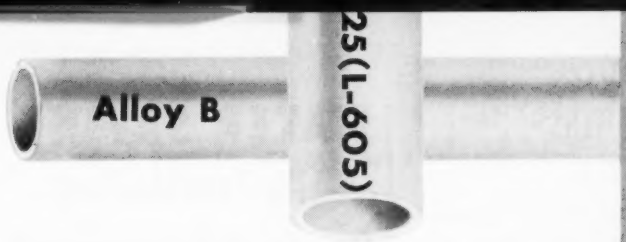
SUPER STAINLESS AND HIGH ALLOY GRADES

Zircalloy II	*Hastelloys:*	Invar "36"
Titanium C-55 or C-70	Alloy B	Invar "42"
Stainless No. 20Cb	Alloy C	HiMu "80"
Carpenter 7Mo (329)	Alloy X	430 Ti
19-9DL	Alloy F	N-155
19-9DX	25 (L-605)	

Wide range of sizes, gauges, lengths, forms and finishes for nuclear requirements

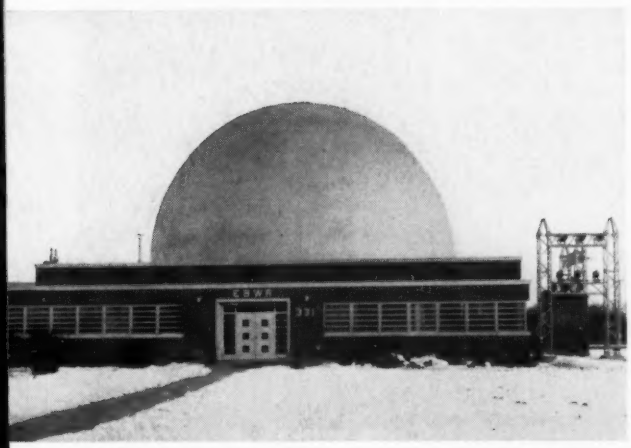
Tubing and pipe sizes available from Carpenter are as follows: *Tubing* from ¼" to 4½" O.D. with 35 BWG (.005") to 9 BWG (.154") walls. *Pipe* of Schedules 5 and 10 in sizes of ⅛" to 4" and Schedule 40 up to 2" IPS. Finishes range from as-welded to high polished. Regular lengths to 45 ft. with longer lengths when specified. Many shapes other than round can be supplied to order.





experience
Alloy Tubing and Pipe

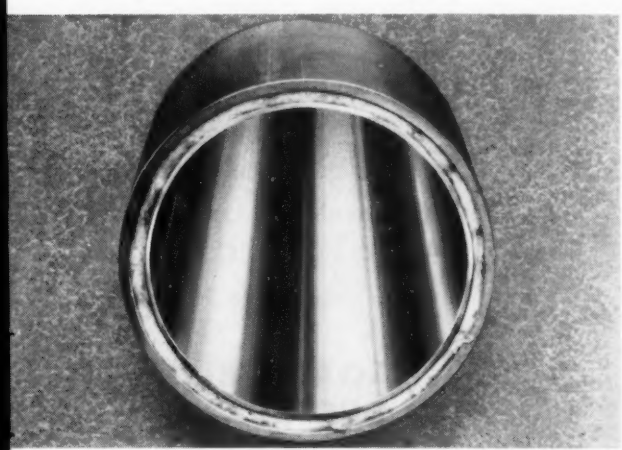
Carpenter Stainless Tubing is being used in many heat exchangers such as this one for nuclear energy applications. Carpenter quality and ability to meet extremely close dimensional tolerances make Carpenter Tubing ideal for use in heat exchangers.



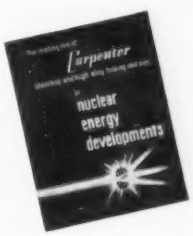
Carpenter has supplied square-shaped tubing for the boiling water reactor in the first nuclear power plant built specifically for electric power generation in the U.S., the 5000-kw experimental plant now in service at Argonne National Laboratory. Illustrated is a front view of the Experimental Boiling Water Reactor. Carpenter also supplied the tubing for the primary heat exchanger for a similar commercial-size plant under construction for a large Mid-West utility.

Photograph courtesy of General Dynamics Corporation

Reprocessing nuclear fuel on the Submarine Intermediate Reactor for the "Seawolf" calls for the use of super corrosion-resistant Carpenter Stainless No. 20Cb in tubing, sheet and plate forms.



Extremely close dimensional tolerances and polish requirements were met by Carpenter in nearly 500 feet of stainless tubing installed in an AEC nuclear power aircraft test facility. Compressed air forces radioactive particles through the tubing, which passes through a 32½ ft. thick concrete wall shielding the reactor. Temperature inside the tubing during operation ranges between 1600° F and 2000° F.



If you are concerned with the design, construction or application of nuclear power equipment requiring tubing and pipe, draw on the broad and extensive atomic experience of Carpenter's technical staff and production facilities. Plan to see our representative soon and send for Bulletin.

R 12-57

MEMBER

The Carpenter Steel Company
Alloy Tube Division, Union, N. J.

Export Dept.: The Carpenter Steel Co., Port Washington, N. Y.—"CARSTEELCO"

Carpenter

Stainless Tubing & Pipe

Ashes, coal and other substances under foot often make solid floors in boiler rooms unsafe.

Such hazardous materials cannot accumulate on a floor made of Irving open steel grating. Debris falls right through, making floors always clean. Dangerous fumes can escape through open grating. Floors made of Irving Grating are clean, safe at all times . . . no ankle turning, tripping, slipping, hot foots. It is fireproof, self-ventilating.

Manufacturers of Riveted, Pressure-Locked, and Welded Gratings of Steel, Aluminum and other metals.

"A FITTING GRATING FOR EVERY PURPOSE"

IRVICO

IRVING SUBWAY GRATING CO., Inc.
Originators of the Grating Industry

Offices and Plants at
5002 27th St., LONG ISLAND CITY 1, N. Y.
1802 10th St., OAKLAND 23, CALIFORNIA

COOLING TOWERS

Continued from page 212

is not fixed either. It may apparently vary from perhaps 10 minutes minimum to an almost unlimited maximum.

Chlorine gas is highly toxic to the skin and tissues and must be handled with care. If chlorine cylinders or proportioning devices are located indoors, provide gas masks and effective ventilation devices. Thoroughly instruct operators of the hazards involved and the use of protective equipment.

Other chemicals can be used to control algae. They may be more expensive or not as effective, but they are easier to proportion and less dangerous to use. For a small tower, bleaching powder (sodium hypochlorite) which releases free chlorine as it dissolves in the water may be OK. A solution of copper sulfate in water is also easy to use, but is not as effective against all types of algae.

Spray ponds act much the same as natural-draft towers, but they do not have as effective air movement. Head supplied by the circulating-water pump —usually 5 to 10 psig—breaks up the water as it sprays out of nozzles mounted along the distributing pipes. Air movement depends largely on wind velocity, although some small movement may be induced by temperature differences above and alongside the spray area. With high winds the water loss may be large and troublesome.

Some plants put a louvered enclosure around the pond to try to control this loss. However, this reduces air movement. You need a much larger basin than for the same capacity cooling tower and as the basin becomes large, fresh cool air has increasing difficulty in reaching the center of the spray area. Cooling becomes less effective. Algae growth may be a problem in spray pond operation as well as in cooling towers, but cold weather operation is probably less troublesome.

Recirculating ponds are a version of the spray pond. A modified spray system is used to supplement cooling-water flow from a river or stream in dry or low flow periods. This may involve a low weir dam below the circulating-water intake to keep pump suction submerged and hold water where it can be recirculated.

When water leaves the condensers, it's picked up by a special pump and forced up a long distribution pipe laid along the bank or banks of the river upstream from the plant. Spray nozzles along the pipe discharge water over the river bed or pool formed by the dam. Long narrow spray pattern makes for effective water-air contact.

(*Continued on page* 220)

WATER SAVING
with Trouble-Free
Cooling Equipment

● Cools your jacket water for engines or process equipment or electric apparatus. Your closed system keeps free from dirt or maintenance troubles. You can cool air, gases, chemicals, plating baths, quench baths, welding machines, extrusion and drawing machines and hydraulic presses. You get real precise temperatures, save rejections, lower production costs. Use NIAGARA *AERO* HEAT EXCHANGER cooling with atmospheric air . . . saves water, pumping, piping and power; quickly saves its costs.

Convenient Units up to 30,000,000 BTU Capacity. Write for Bulletin No. 132.

NIAGARA BLOWER COMPANY

Dept. P-6, 405 Lexington Avenue
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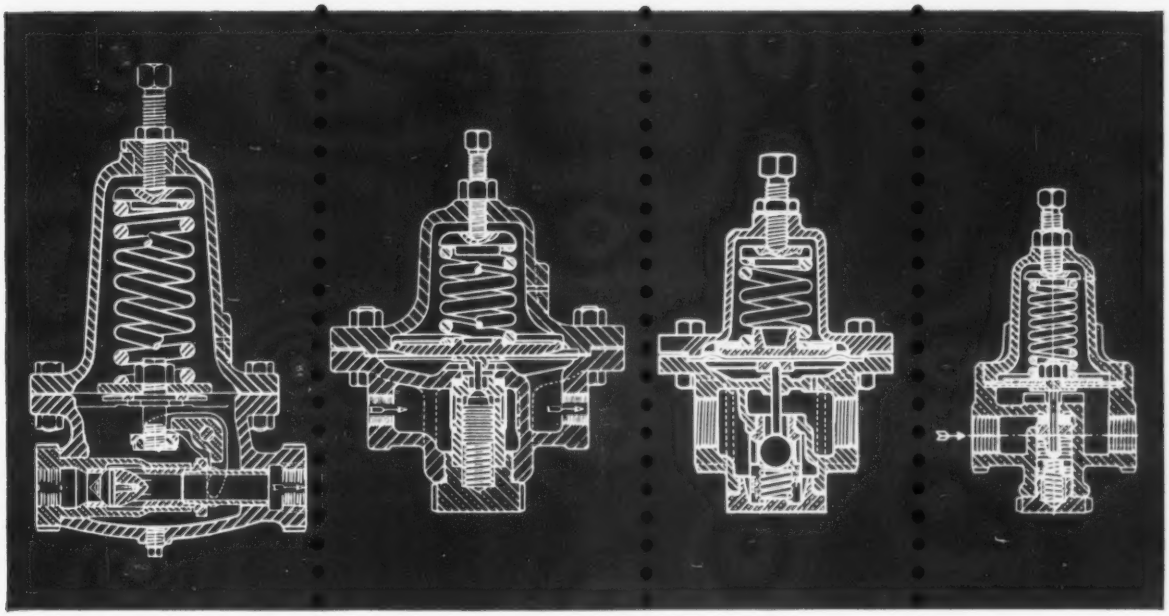
Niagara District Engineers in Principal Cities of U. S. and Canada

What's your pressure problem?

CASH STANDARD

has the answer... *or will find one!*



HERE ARE FOUR TYPES FOR MANY APPLICATIONS

TYPE 1000 — A streamlined, high capacity valve for close pressure regulation—accurate even under toughest working conditions. Closes against the flow, eliminating conditions that cause chatter. Sizes: ¼" to 2", screwed ends. Bulletin 962.

TYPE D — A general purpose regulator with exceptional regulation characteristics. Now improved to permit easier servicing but basically the same dependable valve offered for over 35 years. Sizes: ¼" to 2". Bulletin 950.

TYPE 1260 — A high capacity pressure regulator, small and well proportioned. Available with spherical, self-cleaning inner valve. Suitable for air, water, steam, oil and most fluids and gases. Sizes: ½", ¾", 1", screwed ends. Bulletin S-700.

TYPE 3381 — A small, compact, all-bronze pressure regulator, very accurate and dependable. Available with pressure gauge mounted in one of the two outlet connections. For small lines. Sizes: ¼" and ⅜", screwed ends. Bulletin 948.

There's a Cash Standard regulator for every pressure control problem!

For an individual solution to your control problem, contact the Cash Standard control specialist in your area, or write Dept. E.

CASH STANDARD

A. W. CASH COMPANY, P. O. Box 551, Decatur, Illinois

Pressure, Hydraulic, Temperature, Process and Combustion Controls

POWER

LAMSON & SESSIONS did . . . and doubled production

Before this fastener manufacturer Powered-Up his heating operation, entire furnace charges of steel rod for nut blanks often had to be scrapped. With the installation of modern material handling, rapid induction heating and electrical controls, production was doubled without any increase in plant space. Scrap loss became nil. Another benefit was a substantial improvement in die life. Ask your electric utility sales engineer or your Westinghouse representative how you can Power-Up—how you can use your electrical power more efficiently for more profitable results.

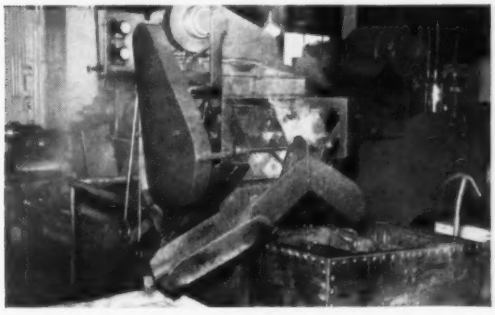
J-97203

YOU CAN BE SURE . . . IF IT'S

Westinghouse

UP!

This rack holds four-hour supply of rod stock. Power rollers feed rod from here into heating coils. Only 90 seconds are required to make the nut blanks.



Hot nut blanks and scrap slugs are unloaded mechanically into separate tote boxes. Divided conveyor keeps blanks and scrap separated.

Accurate heating temperatures are assured by radiation pyrometer and motor-operated rheostat control of M-G sets. One man handles all operations.

ENROUTE TO LONG SAULT DAM

ST. LAWRENCE POWER PROJECT

The first of eighteen gate hoists designed and manufactured by D. J. Murray Manufacturing Co. for the Power Authority of the State of New York St. Lawrence Power Project near Massena, New York, said to be the second largest hydroelectric power producing plant in the world, is shown here as it was ready for shipment from the fabricating plant where the parts were assembled. Loaded on a special length railroad flat car in the same position as it will be placed over one of the eighteen gates in the big dam, the hoist weighs 93,000 lbs. and is shipped completely equipped, including all electric motors, controls and limit switches, and competely wired, ready for operation when installed at the Long Sault Dam.

Each MURCO Gate Hoist has 175 ton lifting capacity and will control the level of the water in the St. Lawrence River above the dam. The electrically operated hoists will raise and lower the gates in the dam at a speed of 1 foot per minute. The overall length of each hoist is 57 feet, the width 8½ feet, and the height 12½ feet. Every two weeks after the first shipment, another gate hoist will leave the plant for its destination.

MURCO Gate Hoists are designed and built in a wide range of capacities from this large capacity to less than one ton. MURCO Gate Hoists have behind them over 70 years of designing and building experience. Write for complete information and engineering recommendations to meet your specific power dam requirements.

D. J. MURRAY MANUFACTURING CO.
Manufacturers Since 1883
WAUSAU, WISCONSIN

IDEAL TUBE EXPANDERS

You can depend on WIEDEKE quality

PACKAGE BOILER

. . . and Stationary Fire Tube Boiler Tubes can be rolled and flared in one operation with this Modern Parallel Rolling Tube Expander.

See your Dealer or Write us for Bulletin 3400.

Guard holds Flare Roll back—desirable for rolling Tubes closely spaced in thin Tube Sheets.

THE GUSTAV WIEDEKE COMPANY
DAYTON 1, OHIO

COOLING TOWERS

Continued from page 216

Windage and algae may create problems and ice or high water may damage the distributing header in case of floods.

Cooling ponds and lakes are quite effective in cooling power plant water for reuse if the area available is large enough. Here most of the cooling takes place on the water's surface, caused by radiation and evaporation. Water temperature approaches the average daily dry-bulb temperature if cooling surface area is adequate.

See that water discharge and suction lines are well-separated—at least several hundred yards apart. Discharge should be on top of the lake and suction as deep as possible.

Little attention is required except where weeds, fish or ice accumulate to cause screen plugging. If pond size and inlet-water supply is limited, watch concentration level to see that scaling conditions do not develop.

MARMADUKE

Continued from page 148

a half interest in a contract he'd snared that day.

"Deal was to remove 120 concrete piers left standing from the 1906 earthquake. Each pier was 12 feet high and 3 feet square. I didn't know too much about breaking up concrete, but he assured me he had a system that was sure-fire. That's why he could underbid competition. We shook hands. Next day I paid off aboard the schooner, packed my sea bag, and the two of us got into high gear.

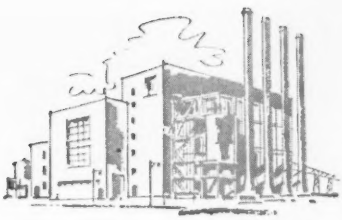
"After working a couple of months with star drills and sledge hammers, we had those piers in chunks small enough to haul away. With that job under my belt, I felt I could break up the Egyptian pyramids, with the Great Wall of China thrown in for good measure.

"My partner wanted to tackle another job, but with money in my pockets I started for my hometown of Milldew, Missouri. That evening in Oakland, I grabbed a side-door pullman on a Missouri Pacific train heading east.

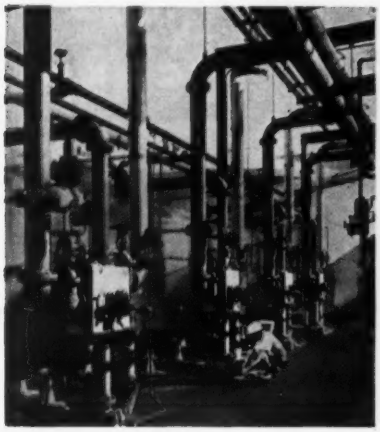
"A few nights later, we pulled into Reno, Nevada. After a night's shuteye at a swanky flophouse, I navigated towards the stockade to get the lay of the land. There was a lot of activity at a new gas holder and plant building that had just been completed. Lumber, tools and equipment were being loaded into the wagons.

"The big attraction was over near the gas holder where two husky guys with

First in water conditioning

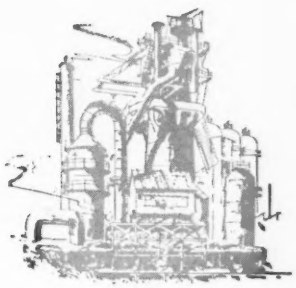


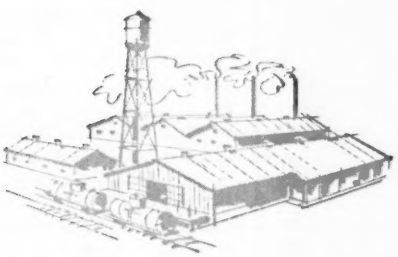
This Giant Cochrane Sodium Zeolite Plant at Rayonier, Inc., consists of 11 units 10'0" in diameter and 5'0" high. Automatically controlled with Cochrane Hydromatic Valves, these units are capable of treating up to 11,000,000 GPD.



Cochrane *automatic* Zeolite Softening

at RAYONIER'S GIANT JESSUP PLANT





To produce high-quality cellulose requires high-quality water. At Rayonier's Jessup, Ga. plant, more than 20 million gallons of water are softened daily—and all of it softened automatically to zero hardness by 11 Cochrane Zeolite Softeners.

The softeners in this installation are controlled by Cochrane Hydromatic Valves, which in turn are controlled by Cochrane Automatic Timers. Every phase of the cycle—service, backwash, regeneration, rinse and back to service are all automatically controlled.

Zero hardness water is guaranteed. There is no possibility of error in operation or of contaminating the treated water.

Cochrane's leadership in water conditioning, and its complete line of equipment assure you unbiased recommendations for equipment to performance requirements. For complete information on Cochrane Zeolite Softeners, write for Publication 4520-A.

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MARMADUKE

Continued from page 220

sledge hammers were pounding away on a small hunk of concrete. All the sidewalk superintendents in town were taking in the show. There were ranchers, indians, cowboys and other local western characters. Some of them were wise-cracking and ribbing the two boys manning the sledge hammers. I walked closer to rubberneck.

"In a few minutes, the boss came along to see how his boys were doing. I asked him about those foundations. He explained that his contract terms required him to raze them. One, which he'd poured when starting the job, had been used for a large two-stage air compressor. A lot of compressed air was used to rivet the gas holder, but the compressor had been torn down soon as the job was finished. The smaller foundation was for the large motor that drove the compressor through a flat belt.

"The compressor foundation was U-shaped, 24 inches high by 30 inches wide and measured 16 feet around the outside. The motor foundation was only 30 by 30 by 18 inches high. Compared to the pier job I had just polished off in Frisco, this was child's play.

"We had the crowd around us by the time the boss finished explaining the job. He was a decent guy, but the way his boys were going about breaking up that foundation was a laugh. So I said as politely as I could, 'Your two muscle boys here might know something about construction work, but they're sure making a federal case of that foundation. Any schoolgirl could finish up that pebble in a couple of hours.'

"That did it. The two strong boys threw down their sledges and headed for me. 'Just what do you think you could do with those foundations?' piped the boss before anything started. That's exactly what I'd hoped he'd say.

" 'Here's my proposition,' I said. 'I'll tackle that big U foundation by myself. If I don't have it broken up before these two playboys knock the dust off that little hunk of concrete, I'll do the job for free. If I break it up before they do, you owe me 100 fish.

"That stopped him cold. 'This guy's loco,' said one of the sledge slingers out of the corner of his mouth. 'Take this city slicker on, Boss. Grubby and me'll make a monkey outa him. And I got ten silver dollars here in my pocket says you can't do it,' he yelled at me.

"When I pulled out my fat bankroll to cover his bet, all hell broke loose. Fists clinching silver dollars came poking at me from every direction. 'I'll take some of that dough,' they were

You Can't Find the Cost of a Valve on a Price List

With today's high maintenance expense, the cost of keeping a troublesome valve in repair can dwarf its original price in a few months' time. The minute a maintenance man touches a wrench to a valve, its cost is often doubled. That's why the purchasing trend is to *top quality* — the longest-lasting, most dependable industrial equipment on the market. And in the valve field, that means Lunkenheimer . . . famous for quality and maintenance-free service since 1862. The Lunkenheimer Company, Box 360 Annex Station, Cincinnati 14, Ohio.

The cost of a Lunkenheimer Valve gets smaller...and smaller...and smaller... with each passing year of dependable service

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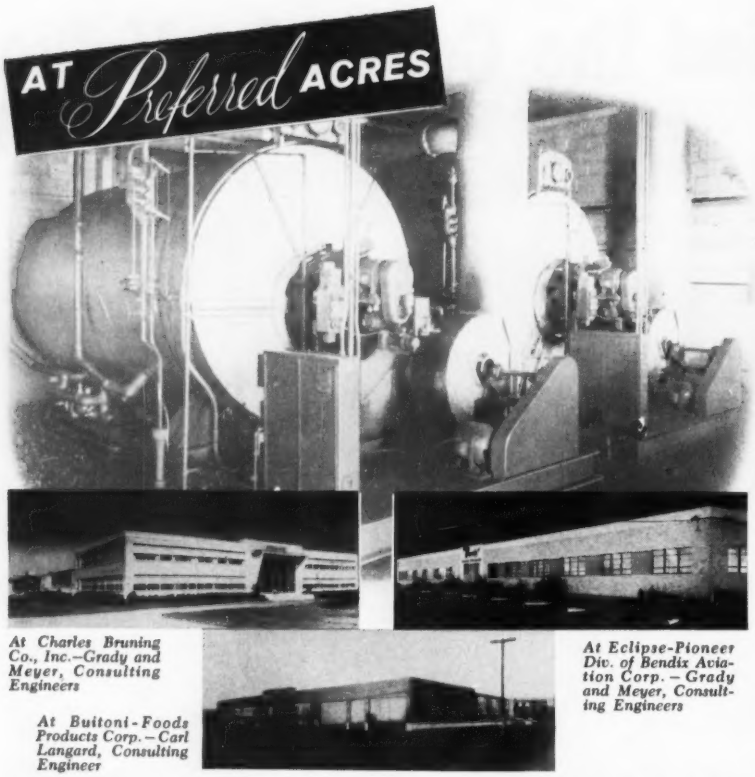

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At Eclipse-Pioneer Div. of Bendix Aviation Corp. – Grady and Meyer, Consulting Engineers

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MARMADUKE

Continued from page 222

yelling. Before I knew it, my bankroll was gone. The boss held the stakes —and he was really loaded. That was silver country.

" 'I can't lose,' said the boss to the crowd. 'If this stranger wins, I'll save money on those foundations. If he loses, I'll still be ahead. So it's a deal with me too, mister. I'll give you 100 dollars if you do it. When do you start?'

" 'Soon as you have a blacksmith shop make me some feathers and wedges,' I told him. 'Here, I'll sketch them on this old envelope. And I want a 1½-in. star drill and a heavy hand hammer.'

"The feathers I sketched were half-round pieces of the same diameter as the star drill and about 6 in. long. The wedges were to be the same width as the star drill. He studied my sketches, then said he'd go two blocks away to the Lucky Horseshoe and have my tools at noon. 'And make sure they're of high-carbon steel,' I added.

"The muscle boys went back to their foundation and really started pounding away. I took a star drill and hammered away while sitting on the big U foundation. By then I had a capacity audience. I placed the drill near the ground and started pounding a hole 6 inches deep, parallel to the ground. After the first hole was deep enough, I moved about two feet and started my second hole. By noon I had holes at ground level, every two feet or so around the outside and inside of the big U-foundation. All this was done sitting down, working between my knees. The two strong boys at the small foundation were pounding away on their concrete points like demons.

"Some scuttlebutt was flying around that I'd blow that foundation with nitroglycerin or dynamite; but I didn't talk.

"When the boss showed up with the wedges and feathers after lunch, it seemed that most of Reno was standing by to ogle.

" 'OK,' announced the boss, 'here's your stuff, now let's see some action.' The two rock crushers threw down their sledges, and came over from their foundation to watch.

"I sandwiched the tip of a small wedge between a pair of the half-round feathers. Then I placed the three pieces into the first hole and tapped the wedge lightly to expand the pieces into the hole. When the holes were filled, I lit a cigar, then selected an 8-pound sledge from the tools on the ground. I walked leisurely from wedge to wedge, puffing away and giving each wedge a hefty tap by swinging my sledge with one hand.

"I just kept navigating slowly around

(*Continued on page 227*)

ECONOMICAL FROM EVERY ANGLE

'AMERICAN' "Every Angle" THERMOMETERS

No longer is it necessary to fuss and figure what angles of stem connection are required in thermometers for each location. These American "Every Angle" Dial Thermometers can be set at any angle within 180° on *two* axes – set at the best angle for easiest reading.

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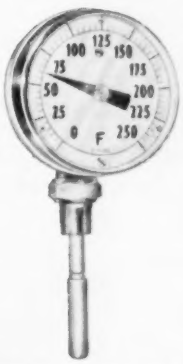
Bi-metal . . . mercury . . . vapor pressure – all three types of actuation are available in American "Every Angle" Dial Thermometers. They are precision instruments that assure accuracy within 1% of scale range. Their high accuracy is sustained throughout service life, whether installed indoors or outdoors.

Make full use of these highly sensitive thermometers at all important check points in your plant. You will maintain product quality far better than ever before. Your field operators will be able to take readings more easily, more accurately, more frequently – will save time-stealing trips to the control house. Convince yourself of the all-around economy of American "Every Angle" Dial Thermometers. Write for complete information.

BI-METAL ACTUATED, TYPE 6060AH. 5" Anti-Parallax Maxivision Dial. **Temperature Ranges:** –80/120 F. to +200/1000° F. **Stem Lengths:** 4" to 24". Climate-proof stainless steel case.

MERCURY ACTUATED, TYPE 6042RM. 4½" Anti-Parallax Maxivision Dial. **Temperature Ranges:** –20/120° F. to 200/1000° F. **Stem Lengths:** 4" to 24". Climate-proof glass and stainless steel case.



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Separable sockets can be supplied in all materials and sizes normally required.

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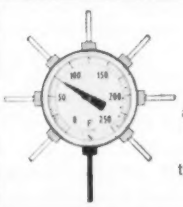

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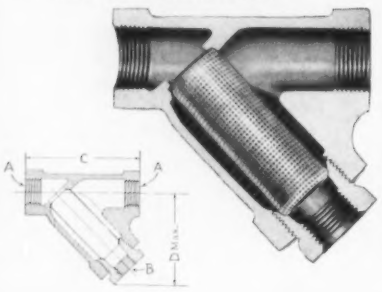


NO. 400-A "Y" STRAINER

Hoffman No. 400-A "Y" type, self cleaning dirt strainers are furnished with a .025 brass screen with .045 perforations. Precision machined, semi-steel body. For use on steam, water, oil, air, or gas service. Made in ½" through 2" pipe sizes. Maximum pressure 125 lbs. Can also be furnished with monel or stainless steel screens.

ROUGH-IN DIMENSIONS			
Size A	Cleanout B	Length C	D
⅛"	¾"	3 13/32"	3"
¾"	½"	4 1/8"	3 7/16"
1"	¾"	4 3/4"	4 1/16"
1¼"	1"	5 7/16"	4½"
1½"	1¼"	6¾"	5 5/16"
2"	1½"	7 7/16"	6⅛"

125# SEMI-STEEL BODY—.025 BRASS SCREEN WITH .045 PERFORATIONS

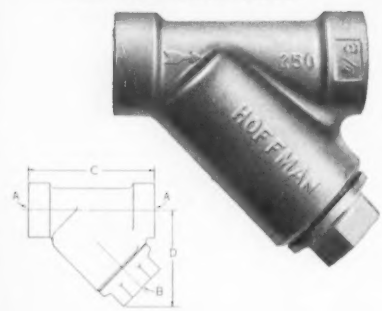
SIZE	SCREEN RATIO* .045 Perf.	WEIGHT LBS.
½"	5 to 1	1½
¾"	4.46 to 1	2½
1"	4.1 to 1	3¾
1¼"	3.26 to 1	5¼
1½"	3.13 to 1	7½
2"	3.3 to 1	11

Monel and stainless steel screens with .033 or .045 perforations and brass screens with .033 perforations available at additional cost.

*Ratio of total effective screen area to the inside pipe area.

SERIES No. 411A

250 PSI—SEMI-STEEL



NO. 411-A "Y" STRAINER

Hoffman No. 411-A "Y" strainers can be used for steam, water, oil, air, or gas service. Made of semi-steel, these strainers are precision machined for correct alignment and easy removal of the strainer screen. Available in sizes ½" through 3", with a .025 monel screen with .045 perforations. Brass and stainless steel screens available. Max. press.: 250 P.S.I.

ROUGH-IN DIMENSIONS			
Size A	Cleanout B	C	D
⅛"	½"	3 7/16"	2 3/16"
¾"	½"	4 1/4"	3 1/16"
1"	½"	5"	3 3/16"
1¼"	½"	5 7/16"	4 1/16"
1½"	¾"	6 3/16"	4 3/16"
2"	¾"	7 7/16"	6"
2½"	1¼"	9"	6 1/16"
3"	1¼"	10¾"	8"

250# SEMI-STEEL BODY—.025 MONEL SCREEN WITH .045 PERFORATIONS

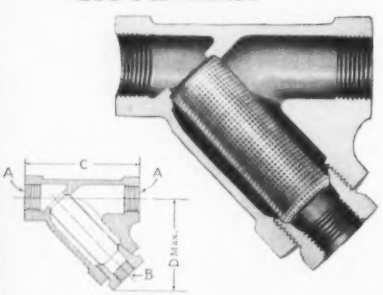
SIZE	SCREEN RATIO* .045 Perf.	WEIGHT LBS.
½"	6.3 to 1	1¾
¾"	6 to 1	2½
1"	5.5 to 1	4½
1¼"	5.2 to 1	6½
1½"	5 to 1	8½
2"	4.8 to 1	13½
2½"	4.2 to 1	19
3"	3.7 to 1	30

Brass and stainless steel screens with .033 or .045 perforations, and monel screens with .033 perforations, available at additional cost.

*Ratio of total effective screen area to the inside pipe area.

SERIES No. 421A

250 PSI—BRASS



NO. 421-A "Y" STRAINER

Hoffman No. 421-A—cast brass, precision machined, "Y" strainers are designed for use on steam, air, gas, water, and oil service. Available in sizes ½" through 3", with a .025 monel screen with .045 perforations. Stainless steel and brass screens available. Maximum pressure: 250 P.S.I.

ROUGH-IN DIMENSIONS			
Size A	Cleanout B	C	D
⅛"	¾"	3 13/32"	3"
¾"	½"	4 1/8"	3 7/16"
1"	¾"	4 3/4"	4 1/16"
1¼"	1"	5 7/16"	4½"
1½"	1¼"	6¾"	5 5/16"
2"	1½"	7 7/16"	6⅛"
2½"	1¼"	9"	6 1/16"
3"	1¼"	10¾"	8"

250# BRASS BODY—.025 MONEL SCREEN WITH .045 PERFORATIONS

SIZE	SCREEN RATIO* .045 Perf.	WEIGHT LBS.
½"	5 to 1	1¾
¾"	4.5 to 1	2½
1"	4.1 to 1	4
1¼"	3.3 to 1	5¾
1½"	3.3 to 1	7¾
2"	3.3 to 1	12½
2½"	4.2 to 1	22½
3"	3.7 to 1	35½

Brass and stainless steel screens with .033 or .045 perforations, and monel screens with .033 perforations, available at additional cost.

*Ratio of total effective screen area to the inside pipe area.

Cast Brass "Y" Strainers available for 400 PSI max. oper. pressure.

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MARMADUKE

Continued from page 224

that foundation, swinging my sledge with one hand and blowing smoke rings. The crowd was really interested in seeing what would happen.

"Ten minutes later, there was a cracking noise and the job was done. The entire foundation had burst level with the ground, as if it had been sawed flush. A roar went up from the crowd; some guys were cursing.

" 'That's the slickest trick I've ever seen,' said the contractor, shaking my hand. 'You've taught me a lesson I should have learned before.' Then he unlocked a tool chest and told me to get my money. 'And here's my 100 dollars,' he said, reaching into his pocket.

" 'Your boys can carry on from here,' I told him. 'Have them break this big U into pieces the same way I split it.' Then I loaded that money into my bowler.

" 'Now I'll give you a little advice,' I said. 'Next time, be sure to drill those holes into the foundation with air hammers before you remove the air compressor. And here's something else,' I added, 'wedges and feathers were used by the Romans two thousand years ago. And it wouldn't surprise me if the Egyptians used them when building their pyramids.' With that off my chest, I headed for the first gambling house to double my money."—*SME*

Marmy's Mailbox

'Tis here you exchange blasts with the old boy

THOSE RUSSIANS AGAIN?

I read where the Russians claim another first. This time they used an airplane to spray coal dust on ice covered waterways. The blackened areas thaw 10 to 18 times faster than untreated ice.

Marmaduke told about how he melted ice up in Canada some 35 years ago in *Marmy Paints Ice*, POWER, Aug 1952. Only he brushed lampblack and oil over the ice. It was the first time I heard about that trick. And I'll bet those Russians read that story, too. They could at least have given Marmy credit. As for me, I read all the Marmy stories and believe me, I learn plenty.

F A CLAFFEY, *Orlando, Ga.*

OLD-TIME ENGINEER

Marmy reminds me of several old stationary engineers I knew before the war. Marmy is a grand old guy and

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If you haven't checked your tube cleaner equipment lately, now is the time to make sure it is ready for service when you need it.

Order needed repairs, heads, cutters, brushes, universal joints or hose now, while our stock enables us to make off-shelf delivery. Why wait? Do it now and avoid possible costly delays. Write, wire or

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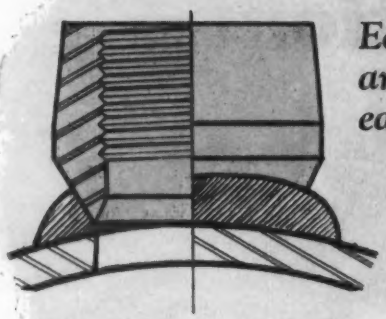
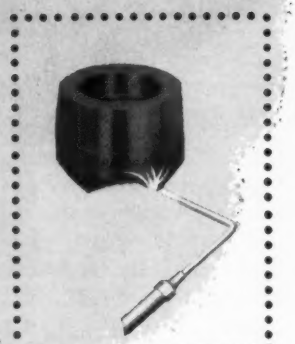


Economical and easy-to-install



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W-S Couplets are designed to function as universal outlet connections for tanks, process vessels and pipelines. They eliminate the need for large, expensive field inventories and costly delays in fabrication.

On most tank, and large piping installations they are used as received. On those few applications where attachment is to be made to a small diameter pipe, the W-S Couplet is easily modified by contouring the welding end with an acetylene torch to mate with the curvature of the pipe. Couplets are made with extra length and heavy wall to permit contouring without detriment to the threaded or socket end.

W-S Couplets are available in sizes ¼" through 2", with screw-end or socket-welding dimensions ... also in a 90° elbow.

Send for Bulletin CP-1-57. Write to W-S Fittings Division, H. K. Porter Company, Inc., P. O. Box 95, Roselle, N. J.

HKP W-S FITTINGS DIVISION
H. K. PORTER COMPANY, INC.

MARMY'S MAILBOX

Continued from page 227

I'd like to sit in his office and listen to him sound off sometime. Good luck to him, hope he keeps roaring in his foghorn voice for a long time to come.

C J PARKER, *Pittsfield, Mass.*

BETTER MUSHROOMS

Stopping that leak in the dam by grouting it closed and leaving a pipe to handle leakoff while cement dried is a good idea. We are going to try Marmy's technique in our large mushroom cave. We'll lead off the percolation water through a plastic tube to the sewer.

On estimating the boiler load for our cave, I stumbled on a huge heat thief; the percolation water that constantly wets large areas of mine surfaces. As we try to put some 20,000 cfm of fresh air at low humidity into our cave, these surfaces commence evaporating. That not only chills the air but promptly saturates it as well. We tried grouting the percolation seams, but each time we did, the mounting hydrostatic pressure just doubled the flow in the adjoining seams. So now we'll try Marmy's method.

P M STURGES *Stone Ridge, N. Y.*

REFRIGERATION IS HIS MEAT

The engineers at this plant all enjoy the Marmy stories. Has he ever solved a refrigeration problem?

W R SIMMS,
St Anthony, Newfoundland, Can.

EDITOR'S NOTE: Yes sir, Marmy has solved some real tough refrigeration problems. But he had to put a horse in a church steeple in one of them to do it. See *Marmy Horses a Compressor*, first story in his book of 21 yarns.

OUR HERO GOES TO SEA

Several hand-me-down copies of POWER found their way aboard ship last trip. After reading the Marmaduke stories in each issue, we laughed our heads off. Our boys enjoyed these stories so much that I'm sending $1.00 for his book. I congratulate the author of these stories.

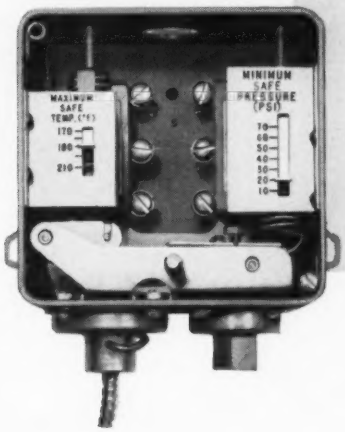
E C SILVA, *San Pedro, Calif.*

SHOVEL NEEDN'T FLY?

In March 57 POWER, Marmy could have gotten that power shovel across the river a lot easier than running it a half mile up river to a shallow spot. How? I would have liked to see him use that shovel to scrape up his own road across. It was done on one job right here in Vancouver while moving a shovel about the Lynn River.

A W LOVITT, *S Burnaby, B. C.*

Temperature and pressure set points are inside the case, protected against accidental manipulation. Cover is removed for easy adjustment.



New Diesel engine safety switch

...gives fail-safe protection

This all-new Honeywell safety switch responds to abnormal pressure or temperature to stop or idle a diesel engine, or actuate an alarm circuit.

It combines separate systems for measuring engine coolant temperature and lubricating oil pressure. The temperature system includes an exclusive fail-safe feature, so that in case of damage to its temperature bulb, capillary or diaphragm, the switch responds as it would to excessive temperature.

Temperature and pressure settings can't drift off set points. There can be no false shutdowns due to vibration. Set points are easily adjustable in the field.

Your nearby Honeywell sales engineer will be glad to give you complete information about the new Diesel Engine Safety Switch. Call him today . . . he's near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pennsylvania—in Canada, Toronto 17, Ontario.

● **REFERENCE DATA:** Write for Specification sheet S1010-5 "Diesel Engine Safety Switch."

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MEMPO Products are a series of Metal Polyphosphate chemicals (crystals, powders or liquids) that are modified and/or formulated to meet your individual plant conditions. The exclusive DEADY METHOD is the only comprehensive system of control, through the use of these chemicals, to assure proper results.

The DEADY water treatment laboratories (Chemical and Engineering Specialists) — unequalled anywhere — can prescribe the MEMPO treatment for your problems. The treatment will be applied and periodically checked by a DEADY field engineer using the exclusive DEADY METHOD.

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MEMPO Products have also been applied most successfully to evaporative condensers and industrial air conditioning systems. Complete details are available from

DEADY CHEMICAL COMPANY
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Los Angeles, Cal.

CARNOT ENGINE

Continued from page 93

of cycles listed in Table 1. We will use successive receiver temperatures of 800, 700, 600 and 500 °R. We can then use the Q's already calculated in Table 1 to figure Table 2 below:

Table 2: Cycle performance with source temperature of 800 °R

Receiver Temp	Q_r	$W = Q$	*Cycle* e_t
800	37.98	0	0
700	33.23	4.75	0.125
600	28.48	9.50	0.250
500	23.73	14.25	0.375

Fig. 9 summarizes this data and shows that both thermal efficiency and net work W are inversely proportional to the receiver temperature; but again they are proportional to the temperature differential of the cycle. Using as low a receiver temperature as possible is important to cycle capacity and efficiency. This again demonstrates that cycle performance depends wholly on temperature.

Q_s and W_s also depend on temperature, so we can write $Q_s = CT_s$ then it follows that:

$$e_t = \frac{C(T_s - T_r)}{CT_s} = \frac{T_s - T_r}{T_s}$$

This is the Carnot efficiency and represents the best that can be done by any cycle running between the same temperature levels. Remember that these temperatures are absolute and not F.

We have developed some important thermodynamic basics in this part that should be remembered whenever dealing with thermodynamic problems. In Table 1 we figured a ratio Q/T that proved to be constant at 0.04747 for all temperature levels. We'll use this in the next part to develop basic ideas about *entropy*.

Next part will cover entropy and second law of thermo—in a forthcoming issue.

HEAT PUMPS

Continued from page 76

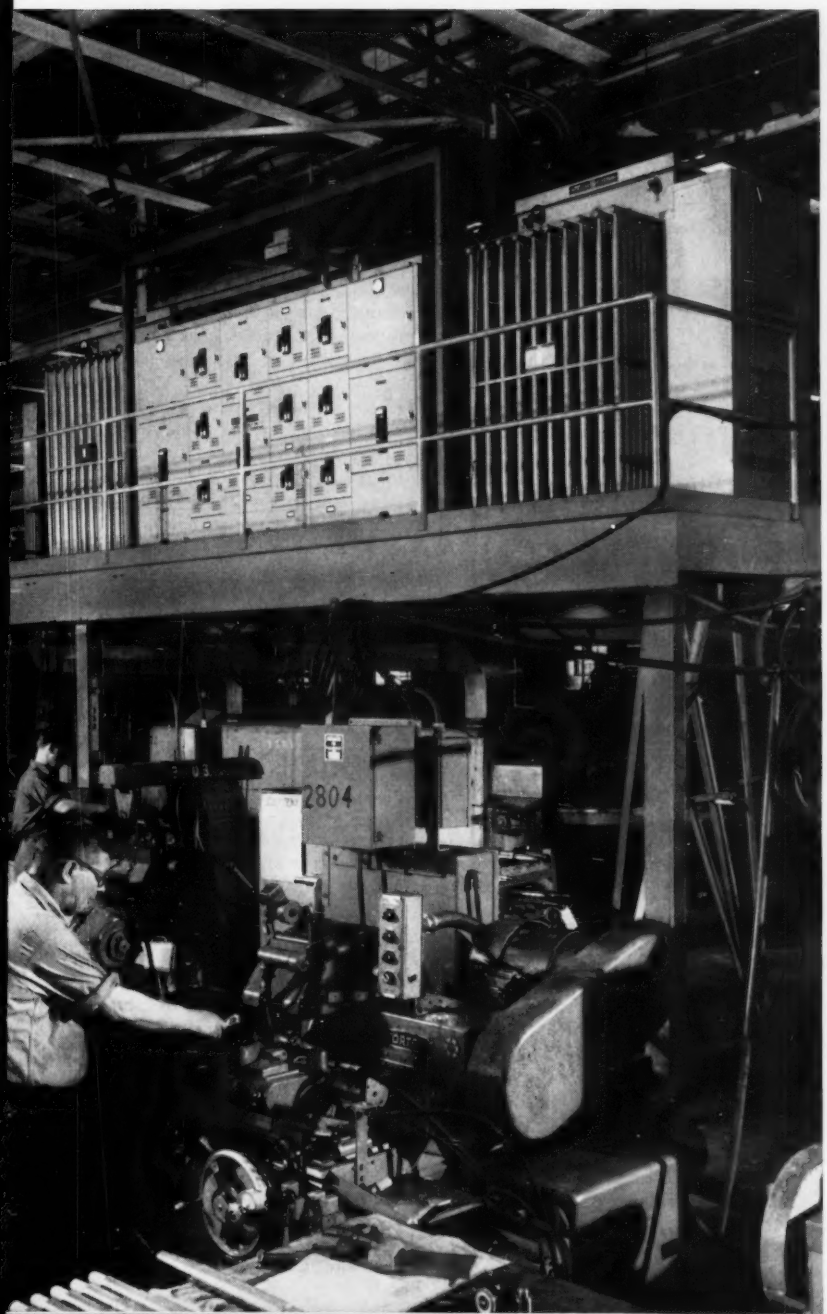
Elimination of flues and stacks increases usable floor space. Thus the heat pump fits in with the architectural design of modern buildings. And air pollution, a serious problem in some areas, is nonexistent.

Today's increased wattage output from lights makes the heat pump look even more favorable. In the past, lighting wattage has been anywhere from

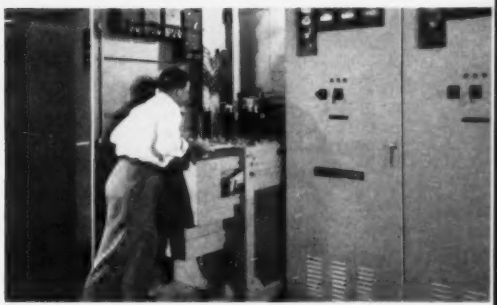
(*Continued on page* 232)

RELIABLE

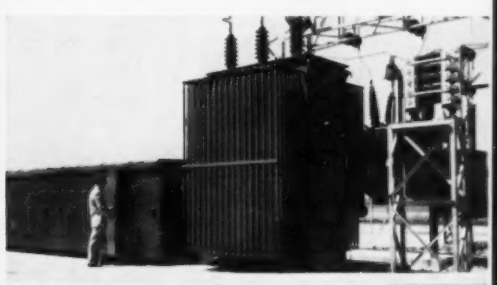
PROVIDE CONTINUOUS PRODUCTIVE POWER IN YOUR PLANT WITH A GENERAL ELECTRIC POWER DISTRIBUTION SYSTEM



The finest electrified equipment in your plant can become useless if your power distribution system is not fully reliable. General Electric metal-enclosed equipment ***in simple circuit arrangements,*** offers you that vital system reliability. For expert assistance in planning and equipping your power distribution system, consult your nearest General Electric Apparatus Sales Office. 680-7



RELIABLE metal-clad switchgear with draw-out magne-blast circuit breakers offers maximum continuity for your plant power system.



RELIABLE General Electric master unit substation reduces high primary service voltages for economical distribution in plant buildings.

To help make your plant's power distribution system:

● **RELIABLE** ● **FLEXIBLE** ● **SAFE**
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HERE'S WHY:

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- The USG Arc-Loc® Movement permits all calibration adjustments of the internal assembly from the rear without removing dial and pointer.
- Sector is stainless steel, with nylon-faced gear section. Nylon-to-metal bond stabilizes the nylon against expansion and contraction . . . assures proper mesh with stainless steel pinion under severe temperature and moisture conditions.
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Supergauges are available in 4½", 6" and 8½" sizes, for pressures to 20,000 psi. Call your local USG Distributor today . . . see the "Yellow Pages" of your phone book . . . or write for complete information on gauge styles and construction.

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HEAT PUMPS

Continued from page 230

2 to 4 watts per sq ft of floor area. Now, 6 to 8 watts per sq ft is common —and some office buildings are going even higher. While this trend boosts air-conditioning requirements, it is also an additional source of winter heat. Result: Size of the summer-cooling load approaches and may surpass the winter-heating load—even in colder climates. Thus we can often size the heat pump for summer load, avoid adding additional capacity for winter heating.

Other applications lend themselves to the heat pump because of their heating-cooling load characteristics. Supermarkets, for instance, need refrigeration to preserve perishable foods. Heat from the system generally goes to the outside air via a cooling tower, evaporative condenser or air-cooled condenser. Instead of throwing away this heat, the heat pump can pick it up, deliver it to the occupied space. Industries requiring process refrigeration also offer excellent potential for heat-pump applications.

First conceived by Lord Kelvin in 1852, the heat pump has come a long way in recent years. But its future looks even brighter. As fossil fuels are depleted, nuclear plants will supply a greater share of our energy needs. But a nuclear reactor in every building to supply heat doesn't look practical from either the cost or safety viewpoints. For the long range, the answer appears to be the central nuclear power plant supplying electrical energy to heat pumps.

SUPERHEATERS

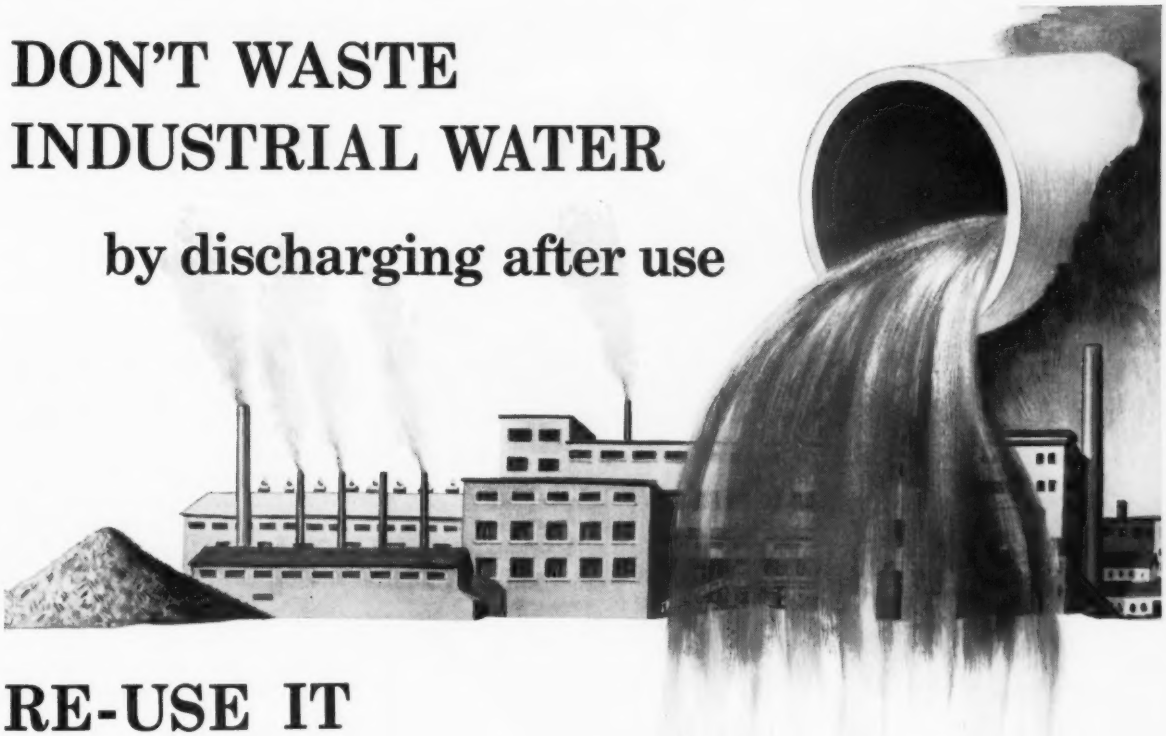
Continued from page 113

board temperature indicator or recorder or any temperature indicating instrument in the steam line remote from the superheater until the boiler is on the line. Temperature rise should be gradual and stay well below the superheater's maximum designed temperature. Any start-up temperature that approaches this maximum is a sure sign that firing rate is too high.

Drum-water temperature is the governing factor, in some cases, in time required to put a boiler on the line. Fig. 2 shows approximate time needed for various drum-water temperatures. Generally accepted rate of water temperature rise is about 80 F per hr. However, this is based on superheater protection and may not be suitable for thick-wall drums. With these, permissible drum-heating rate may take priority and, if your boiler-drum wall thickness is 4-in. or more, your start-up pro-

DON'T WASTE INDUSTRIAL WATER

by discharging after use



RE-USE IT

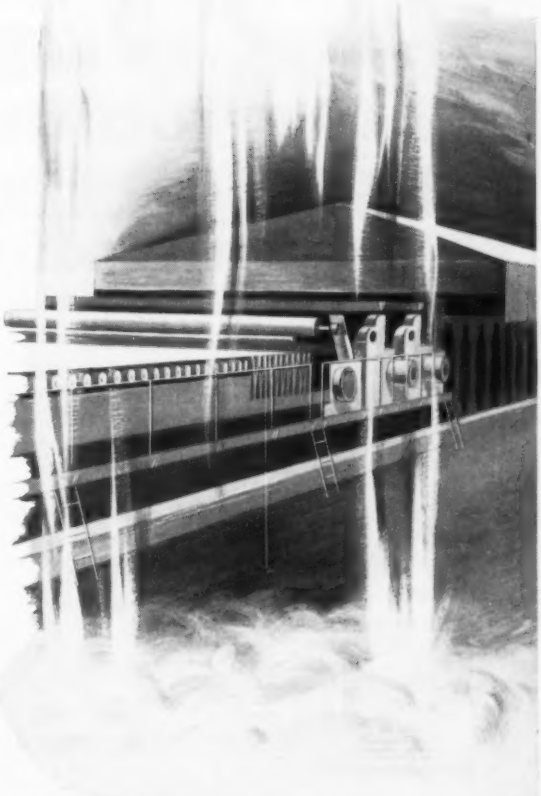
by clarifying with Celite filtration

Recycling your process water instead of discharging it makes good sense in four important ways:

1. It cuts your water costs.
2. It conserves your community's water supply.
3. It helps you meet the high sanitation standards now imposed in many areas.
4. It protects your local rivers and streams from pollution . . . preserves these waterways for recreational purposes.

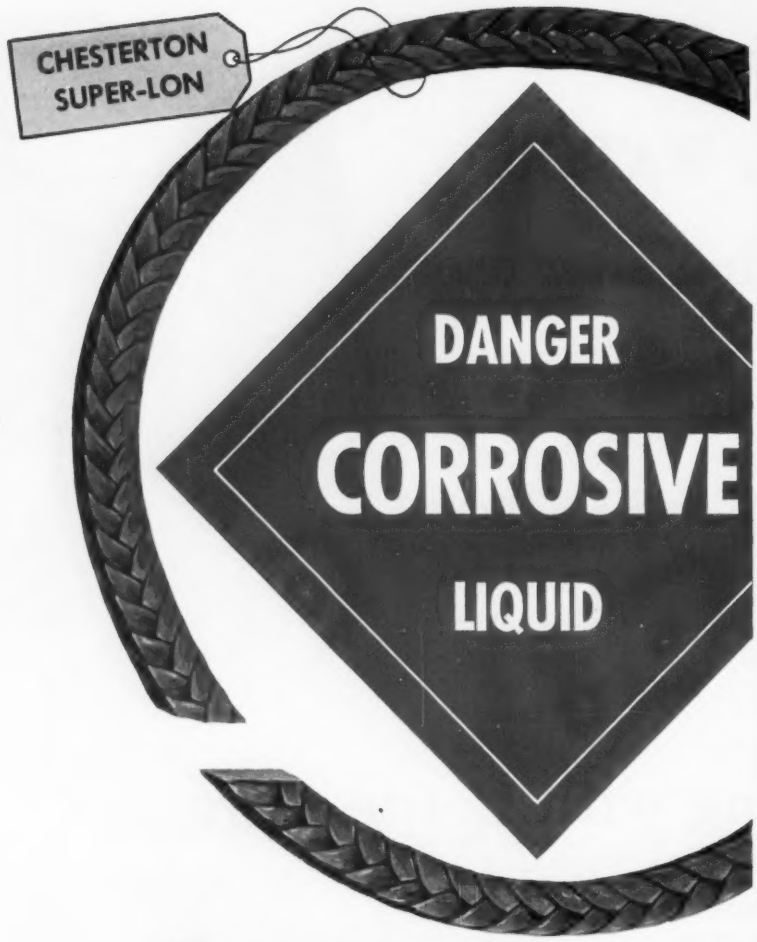
It also makes good sense to use Celite* diatomite for clarifying this plant waste. Celite filtration removes more suspended solids, including amoebae, algae and most bacteria. It operates at fast flow rates with any conventional pressure filter. It comes in 9 standard grades for precise clarity control. And it is low in cost.

A Celite engineer will be glad to study your water problem and offer recommendations with no obligation. Write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.



*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products

Johns-Manville CELITE diatomite filter aids



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SUPER-LON stands all corrosive chemicals up to 550°F with the exception of molten alkali metals.

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SUPERHEATERS

Continued from page 232

cedure should be based on the manufacturer's advice concerning permissible heating rates.

Tests conducted by boiler manufacturers determined firing rates that'll boil water out of superheaters, but still keep metal and gas temperatures within safe limits. Start-up procedures are based on their belief that it isn't always safe to increase firing rate as soon as the nonreturn valve opens and the boiler goes on the line, but that the boiler should be held under start-up conditions until all superheater tubes are cleared of water.

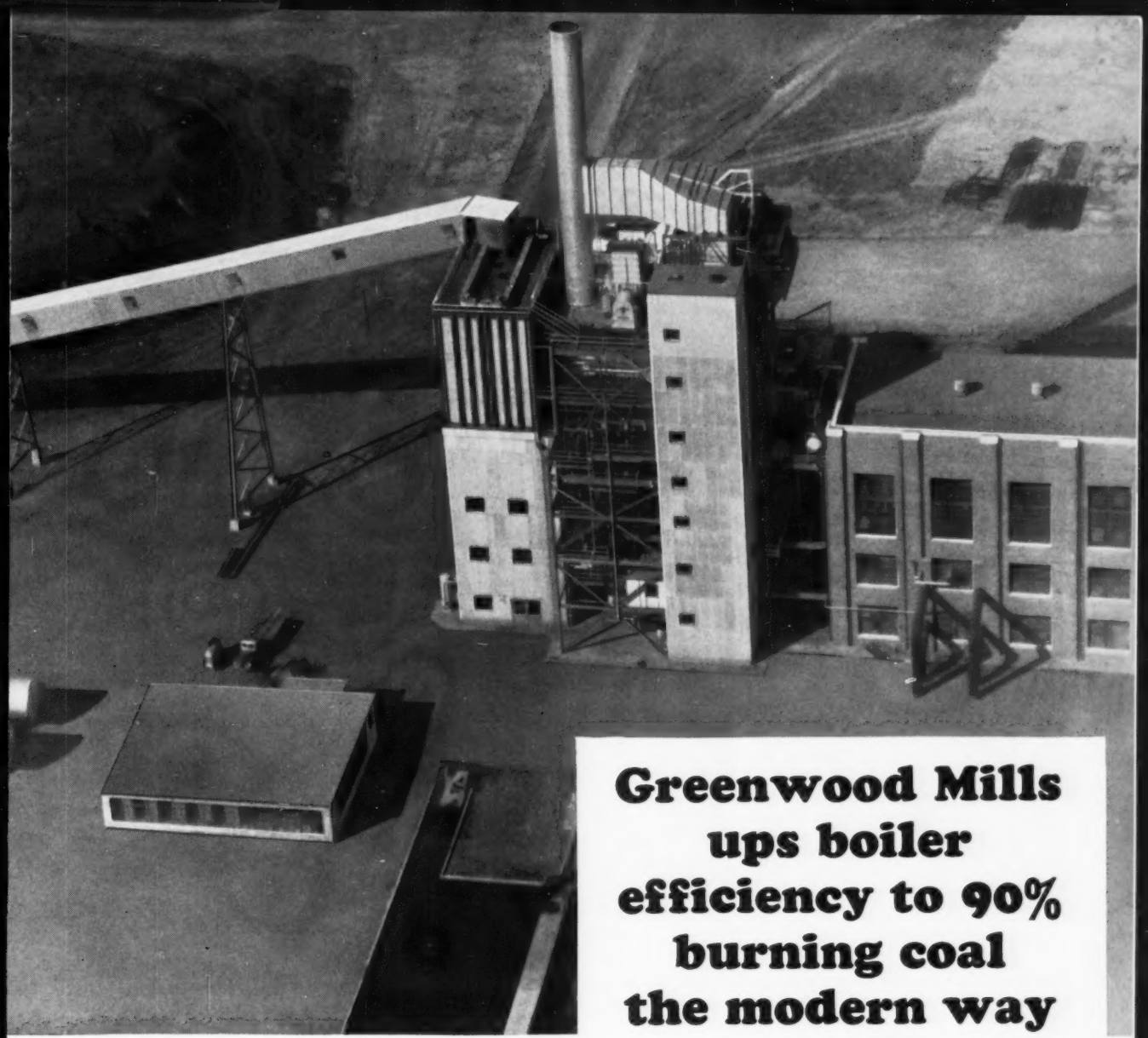
Tests showed that, using proper start-up procedure, an initial gas temperature of 600 F at the superheater will gradually increase to 900 F by the time the boiler reaches line pressure. If pressure rises faster than wanted, because of drum stresses or other requirements, firing rate should be cut back. Fig. 3 shows ideal and actual curves of rate-of-pressure-rise during start-up under proper firing rate.

Coal-burning boilers generally need extra care when going back on the line after a banked fire period. In some cases the banked boiler is just under line pressure, needing only a few minutes' firing to make the nonreturn valve open. However, during the bank, some superheater elements may have become partially full of condensate. If a high firing rate is used before this water boils out of the elements, chance of damage is as great as during cold start-up.

During normal on-the-line periods, superheaters don't need any special attention other than to keep operation within designed limits. Potential trouble-makers are: (1) Secondary combustion, which may damage supports, cause excessive steam temperatures and overheated elements. (2) Misaligned soot blower elements or nozzles. Jets impinging on tubes can cut and badly damage tubes.

Superheater safety valves are purposely set to blow before the boiler safeties. They're located at the superheater outlet where they quickly sense a pressure build-up caused by increased firing rate, reduced turbine load or turbine tripout. By opening first, they keep a protective steam flow through the superheater. If the boiler safety valves opened first, they might reduce steam flow through the superheater to the extent that tubes or elements would seriously overheat.

ED. NOTE: *Based on data supplied by The Babcock & Wilcox Co, Combustion Engineering, Inc, Foster Wheeler Corp and Mutual Boiler and Machinery Co*



Greenwood Mills ups boiler efficiency to 90% burning coal the modern way

Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

When its original power plant could not keep up with growing steam demand, Greenwood Mills, Greenwood, S. C., studied the problem and decided to replace the old facilities.

Greenwood's engineering and construction departments, working with Consulting Engineer Frank Hill of Greenville, designed and built a completely modern power plant. It features a pressurized 300,000 lb./hr. boiler equipped with two cyclone furnaces burning ¼" x 0" coal. Automatic throughout—from coal conveyors to pneumatic combustion control to hydraulic ash handling—the system is manned by a minimum of operators. Burning coal the modern way has resulted in a trouble-free boiler plant operating at a combustion efficiency of 90% or better.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

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How Foster Grant Co., Inc. Added More Steam in 6 Hours

9:00 A.M.

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How to obtain more process steam with minimum time loss is built right into many companies' expansion plans. That's the way it was with Foster Grant Co., Inc., of Baton Rouge, La., a major styrene plastic manufacturer.

Back in '53, engineers of Foster Grant's petrochemical division set down the first two Bros Packaged Boilers. These went on the line, providing steam for the manufacture of FOSTA® styrene products and FOSTARENE® polystyrene. In the plastic boom, more steam was needed, so another BROS unit was installed and, recently, two more. The timed transfer of one of them from flat-car-to-trailer-to-foundation took but six hours.

With the addition of a sixth BROS boiler this spring, these units operated in series will provide a total steam capacity of 180,000 lbs. per hour. Each unit's design pressure is 600 lbs.

Because of the flexibility of packaged boilers operating in multiples, you exercise close control over steam requirements, keeping fuel costs down. Also varying load conditions are easily accommodated.

Design features, fast installation and operating economy make the BROS Packaged Boiler the logical choice in your expansion plans. Capacities range from 8,000 to 50,000 lbs. of steam per hour. Gas or oil fired or combination. Choice of manual, semi or fully automatic controls.

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Write today for the new, factful BROS Packaged Boiler Catalog WT-10; no obligation, of course.

My biggest boner

While in the navy aboard a destroyer, I was ordered to put a hydrostatic test on the soot blower piping on No. 4 boiler.

We had eight soot blowers. I blanked off the inlet flange of each, then pumped the pressure up to 900 psi, or one and a half times working pressure, as prescribed. I then sent for the engineering officer as he wanted to inspect the system personally. He gave the system a quick check. There wasn't a drop of water leaving the system. He was well satisfied, and complimented me on a job well done.

As he left, I looked down at the flange where the pump was hooked to the piping. I noticed that I had placed a blank in that flange too. No water could get to the piping. Not wanting to lose a stripe, I didn't call the chief's attention to this boner. But after liberty started that night, instead of going ashore I went below and removed the blank. Then sweated out putting another test on the system. That taught me a lesson. Now I recheck my work.

F PECHAR *Wallingford, Conn.*

MOTORS

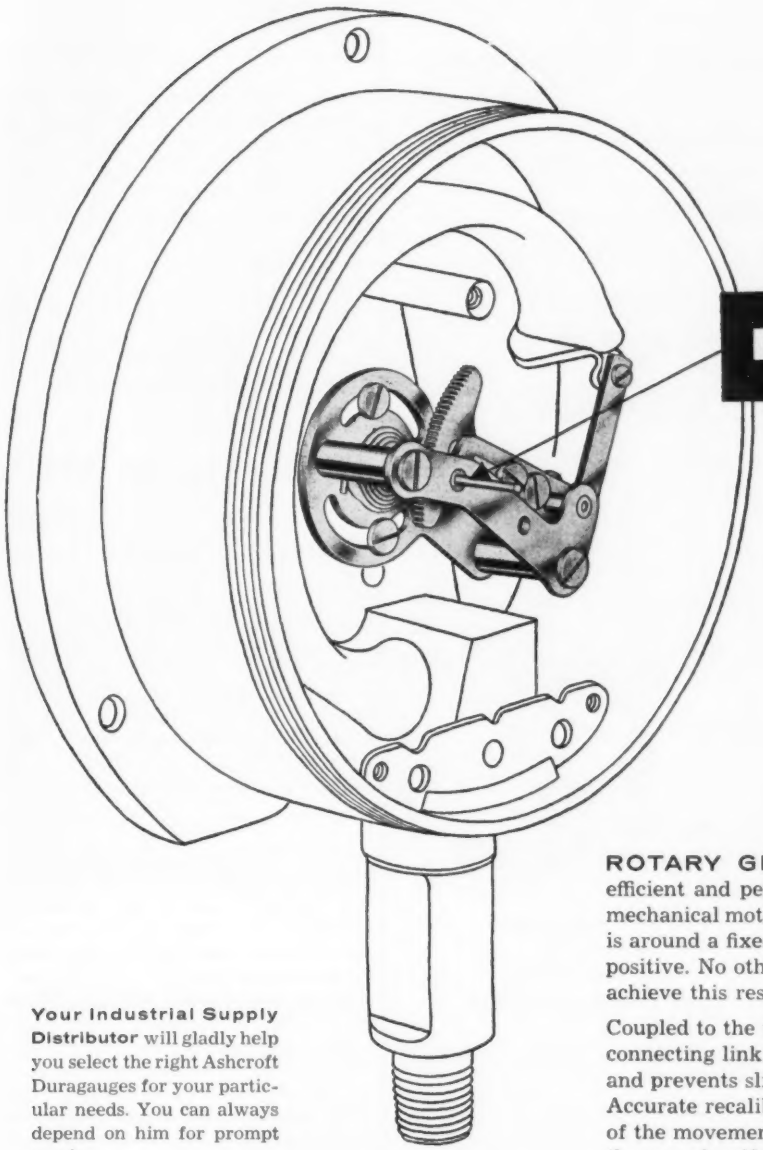
Continued from page 99

more than a standard motor but saves $100, no one can argue that he should purchase a standard motor. On the other hand, if judicious design of the driven equipment permits use of a standard motor at no extra cost, you can, in effect, have your cake and eat it, too.

Tied in with the question of initial cost is the ease of disposition of the motor in case an order for a machine is cancelled. A standard motor is readily disposed of at no loss; a special motor may turn out to be a white elephant.

In the area of delivery, many standard motors are carried in stock while others are available on relatively quick delivery. Special motors require longer delivery, much longer if highly special. Here again, the importance of this factor can only be determined by you. If you can order a special motor sufficiently far in advance, its longer delivery is no handicap. Remember, however, that if a breakdown in service occurs, the longer delivery of a replacement motor or part can be serious.

In the area of quality, it is worth



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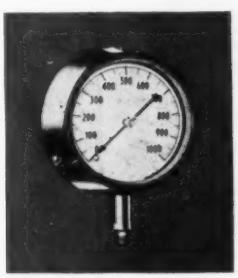
ROTARY GEARED MOTION, the most efficient and perfect method of transmitting mechanical motion ever developed. Because rotation is around a fixed center, pointer position is always positive. No other type of movement can ever achieve this result.

Coupled to the movement is a one-piece connecting link that guarantees correct calibration and prevents slippage or parting under tension. Accurate recalibration is easy from front or rear of the movement. Universal adjustability permits the use of uniformly graduated dials, thereby facilitating maintenance.

The Ashcroft Duragauge is available with all-stainless-steel movement or stainless steel with nylon bearings and pinion gear. There are case designs and materials, Bourdon tube materials, pressure ranges and dial sizes to meet your service conditions exactly. Save time, trouble and money. Specify the pressure gauges of highest sustained accuracy and durability – Ashcroft Duragauges.

Your Industrial Supply Distributor will gladly help you select the right Ashcroft Duragauges for your particular needs. You can always depend on him for prompt service.



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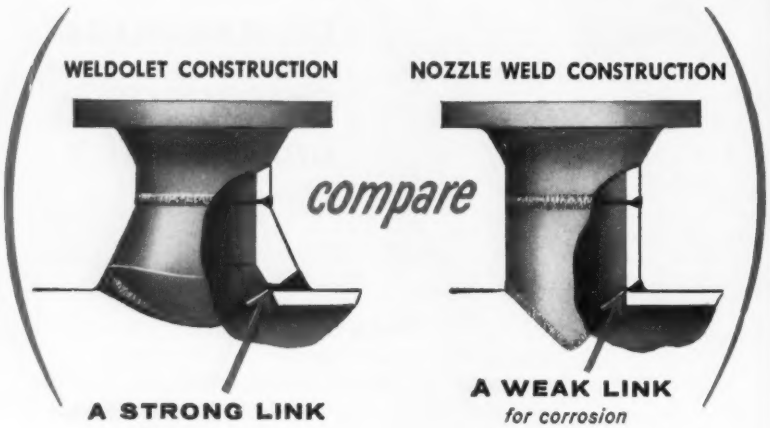
years to your piping

gallons to your flow

strength to an otherwise weak link

add → **BONNEY WELDOLETS**

to your piping drawings for all branch connections



A STRONG LINK
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gallons
strength
and assures a clean, properly fabricated and properly designed branch connection

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for corrosion
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Labor costs are now at an all time high. Reevaluation of your piping costs will now reveal Weldolets 4" and smaller to be less costly to fabricate than unreinforced nozzle connections. In the field this is also true of larger sizes and Weldolets are always more economical than branch connections made by welding tees or reinforced nozzles. Weldolets are manufactured in all sizes from 36" and all weights from xxs, in carbon steel, stainless, alloy, wrought iron and non-ferrous metals.

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PENNSYLVANIA DIVISION

BONNEY FORGE & TOOL WORKS

ALLENTOWN, PENNSYLVANIA DEPT. L

MOTORS

Continued from page 236

noting that progressive manufacturers attain exceptionally high quality in the production of standard motors through the use of modern machine tools. Facilities of this kind are highly specialized, p 97, and their products are literally marvels of precision and accuracy. Unfortunately, this type of equipment is far from inexpensive and can be justified only for high-volume production. Frequently the nature of parts for special motors excludes their production on facilities used for the standard motor.

REPORTS from the FIELD

Begins on page 154

Atoms for industry continued

is shooting for a target capacity of 15,000 mw installed during 1957. Over a ten-year period, it expects to invest $5,250 million. The six powers definitely expect their investment to pay off. They estimate that nuclear power is likely to be cheaper than other fuels, more dependable, certainly, than oil and in any event will save foreign exchange.

With the European picture before them, some observers ask why the U.S. has not embarked upon a more ambitious schedule. The reason is this: the Administration is gearing its atomic power program to development of atomic reactor technology rather than on actual production of electricity. The U.S., unlike the European nations, can proceed at a more leisurely pace because its fuel needs are not so pressing. The U.S. feels that it will better prepare for the future by refusing to sacrifice quality to the expediencies of the present.

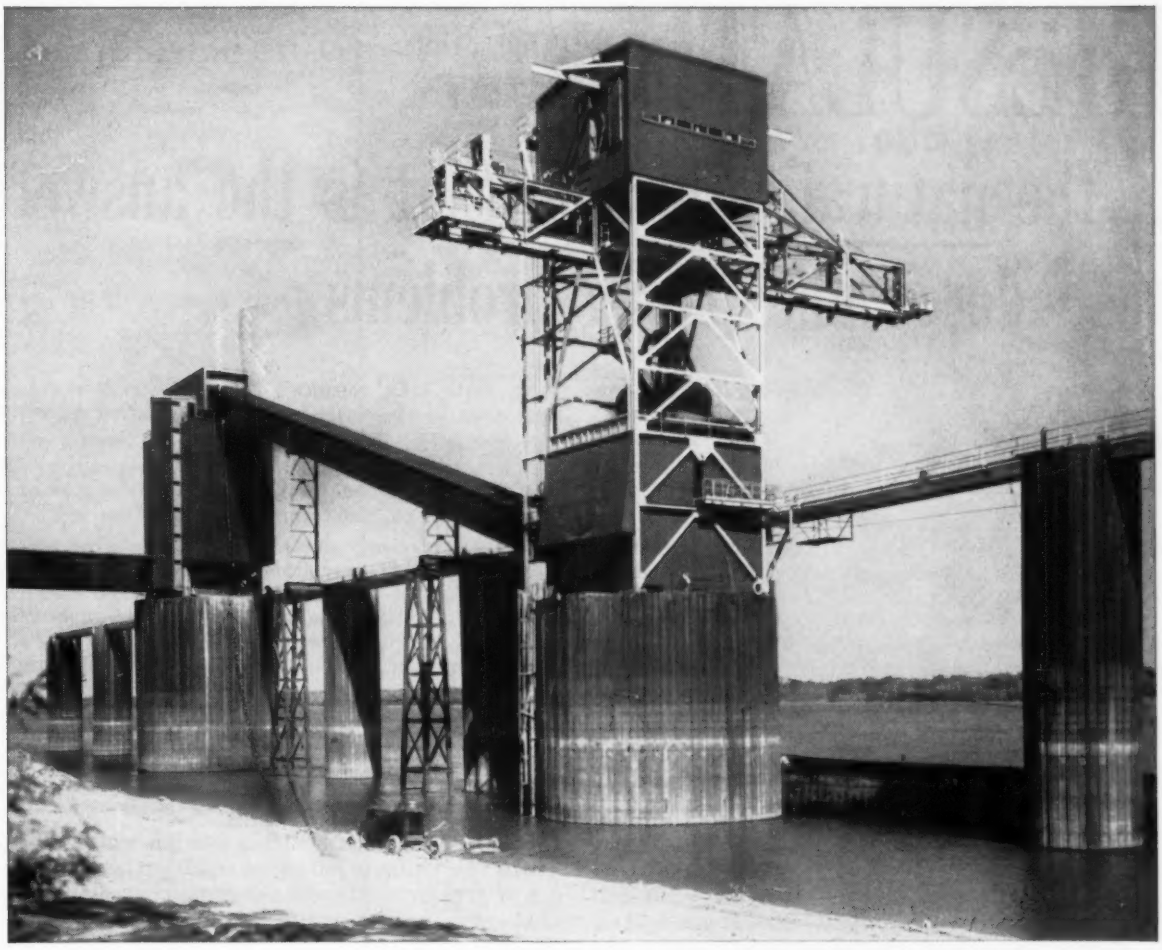
Calendar of Events

June 2-6—Air Pollution Control Assn, Golden Jubilee meeting, St. Louis, Mo. Details from APCA, 4400 5th Ave, Pittsburgh 13, Pa.

June 3-6—Oil-Heat Institute of America, Inc, 35th National Convention. Sheraton-Plaza Hotel, Boston, Mass. Details from Oil-Heat Institute of America, Inc, 500 5th Ave, New York 36, N. Y.

June 3-7—American Society of Civil Engineers, 1957 Spring convention. Hotel Statler, Buffalo. Details from ASCE, Engineer Park, Buffalo 7, N. Y.

June 4-5—American Institute of Elec-



9-ton coal unloader, with free digging capacity of 850 tons per hour, has an average operating lift of 75 feet and travel distance of 40 feet.

Barge unloading?...WE DO THE COMPLETE JOB— unloading tower, dock and all auxiliaries

Dravo experience in the design and construction of complete bulk materials handling installations can help you lower coal handling costs materially. Take the facility shown above. The cellular steel sheet pile dock requires no maintenance, provides safe mooring for barges and supports the barge shifters, other auxiliaries and the unloading tower.

This all-welded tower has a single hoist motor and drum which perform all hoisting and lowering operations. Hoisting rope pull is equalized, and a counterweight reduces hoisting horsepower. A separate drive provides independent and positive bucket closing.

Dravo facilities provide for the design, fabrication and erection of the complete job. Tower, dock and auxiliaries are integrated into a smooth-running installation designed to operate at maximum efficiency and low cost.

Dravo heavy materials handling equipment is at work in power plants, steel mills, port docks and other materials transfer points. You can learn about Dravo's complete line of trolleys, bridges, towers and other related equipment by writing for Bulletin #225. Better still, let us arrange for your visit to actual installations. Simply call us at Pittsburgh, Spalding 1-1200, or write DRAVO CORPORATION, PITTSBURGH 25, PENNSYLVANIA.

DRAVO
CORPORATION

Blast furnace blowers • boiler and power plants • bridge sub-structures • cab conditioners • docks and unloaders • dredging • fabricated piping foundations • gantry and floating cranes • gas and oil pumping stations • locks and dams • ore and coal bridges • process equipment • pumphouses and intakes • river sand and gravel • sintering plants • slopes, shafts, tunnels • space heaters • steel grating • towboats, barges, river transportation

GILSULATE®

Specially sized, selected and blended Gilsonites

...the natural insulation that is the answer to underground piping problems

To Torture Any Thermal Insulation—Bury It! The severest service test of any thermal insulation is burial underground. High humidity, heavy structural loading, a chemically and organically active environment, thermal cycling and pipe movement, and vibration—all these work to break down the insulation.

Why Buried Piping Corrodes: External corrosion of buried piping is variously caused: *Electrolytic attack* occurs when stray direct currents find their way from a piping system to the earth, at which point pitting occurs on the pipe surface. *Galvanic attack* results from current generated when metal touches certain types of soils. *Chemical attack* may include damage by water in liquid or vapor form, earth salts, chemicals from industrial or organic wastes, or by chemicals in various insulating materials.

Gilsulate solves an old problem by surrounding the piping with a material which is a dielectric, is chemically neutral and stable, is a *natural* insulator and which, in the case of buried hot piping, also forms a good vapor barrier.

No other insulation protects buried hot piping completely! Gilsulate is the only insulation which can provide the three *vital* means of protection, and also withstand the destructive forces of burial in the earth. It is physically and chemically stable. It will not dissolve, crush or rot. It is not rigid; therefore, ground and pipe movement will not destroy its effectiveness.

8 Reasons to use and specify GILSULATE

1. IT IS A NATURAL INSULATION

Gilsulate is mined, crushed, screened and blended from pure Gilsonite mineral, a unique hydrocarbon found only in eastern Utah. No chemical or other physical change is made in the natural mineral. It is a *natural* insulation. Gilsonite is mined in an exceptionally pure state with virtually no trace minerals or foreign materials. Gilsulate is specially sized, selected and blended Gilsonites.

2. IT PROTECTS PERMANENTLY

The Gilsulate system solves the problem of insulating underground hot piping permanently—and at low cost.

3. IT CANNOT DETERIORATE

Chemically inert and stable, Gilsulate cannot change with time, moisture or soil. It is impervious to mold, fungus, bacteria, rodents, plant growth and soil chemicals. It has lain unchanged in the earth for millions of years.

4. IT IS PACKAGED FOR EASY HANDLING

Gilsulate is supplied in 2½ cu. ft. sacks. Shipping, storage and handling at the job site are easy. No bulky, heavy units requiring cranes or special tackle—practical packaging for palletized loading or manhandling to hard-to-reach piping locations.

5. ...AND IT IS ADAPTABLE AT JOB SITE

Gilsulate needs no pre-cutting, mixing, assembling or fitting. Last minute job site changes in the piping layout or arrangements will not demand special fittings or changes in the insulating equipment or methods.

6. EASILY INSTALLED

Gilsulate all but installs itself. Just pour it on...tamp it down...heat the piping...backfill. The Gilsulate fuses to form a plastic protective sheath around the pipe.

7. NO SPECIAL FORMING OR MATERIALS NEEDED

Gilsulate adjusts itself to pipe expansion; provides its own vapor barrier. No hand fitting is needed; no special vapor barriers need be installed. Usually, the trench walls and floor are the only forms needed. Sheet metal or wood slip forms may be used if trench is cut wider than the insulating envelope desired. For a single pipe, or complex multiple piping system, *installation is simple.*

8. PIPING ALWAYS EASILY ACCESSIBLE

Gilsulate structure gives the only underground piping system which can be opened and re-installed with only pick and shovel. Alterations and additions to Gilsulate-insulated systems demand no more skill than does altering a fully exposed piping system.

Do you receive
PIPE INSULATION NEWS?
Ask to be put
on our mailing list.

American Gilsonite Company

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3537 Lee Road, Cleveland 20, Ohio
Affiliate of Barber Oil Corp. and Standard Oil Co. of California

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Palmer & Lawrence,
3110 Clairmont Ave. So., P.O. Box 1572, Birmingham

ARIZONA
Carns-Hoaglund Company, 420 N. 15th Avenue, Phoenix

CALIFORNIA
Industrial Insulators, 1356 So. Flower, Los Angeles 15
1372 Ocean Avenue, Emeryville

COLORADO
Joy and Cox, Inc., 2124 Broadway, Denver 2

FLORIDA
George A. Israel, Jr., 115 Park Street, Jacksonville
581 S.W. 47th Ave., Miami 34

GEORGIA
John A. Dodd Co., 299 Techwood Drive, N.W., Atlanta

ILLINOIS
Eagle Industrial Co., Inc., 1021 N. 18th St., E. St. Louis
Roy O. Nelson Company, 330 S. Wells St., Chicago 6

INDIANA
Jackson Engineering Co., Inc.,
1531 N. Pennsylvania St., Indianapolis 2
721 W. Prospect St., Terre Haute

IOWA
Allied Industries, Inc., 736 Federal Street, Davenport

KENTUCKY
Jackson Engineering Co., Inc.,
660 S. 5th St., Louisville 2

LOUISIANA
Edgar Murray Supply Co., Inc.,
232 Canal St., New Orleans 6

MARYLAND
Freemire & Associates, Inc.,
2802 Ridgewood Ave., Baltimore 15

MASSACHUSETTS
Beaulieu and Munroe, 82 Crescent Avenue, Boston 25

MICHIGAN
John F. Wolff Company, 726 Lothrop, Detroit 2

MINNESOTA
Paul W. Abbott Co., Inc., 704 Vandalia St., St. Paul 14

MISSOURI
Anderson-Stolz Corp., 1727-33 Walnut St., Kansas City 8

NORTH & SOUTH CAROLINA
Applied Engineering Co., P. O. Box 506, Orangeburg

NORTH DAKOTA
Lignite Combustion Engineering Corp.,
215 Airport Rd., Bismarck

NEW JERSEY
A. F. Hinrichsen, Inc., 9 Ampere Parkway, East Orange

NEW YORK
H. V. Borgs Co., Inc., 419 E. Jefferson St., Syracuse 2
A. F. Hinrichsen, Inc., 50 Church Street, New York 7

OHIO
William G. Jewett Co., 12417 Cedar Rd., Cleveland 6
The Henry P. Thompson Co.,
1717 Section Rd., Cincinnati 37

OKLAHOMA
Loeffler-Greene Supply Company,
1604 N. W. 5th, Oklahoma City

OREGON
Mead and Associates,
317 S. W. Alder St., Rm 1100, Portland 4

PENNSYLVANIA
Holly Specialties Co., Inc., Walnut Park Plaza Hotel,
Walnut at 63rd Street, Philadelphia 39
J. F. Scouler Company, 221 North 2nd St., Harrisburg
Tufein Equipment Co., P. O. Box 4453, Pittsburgh 5

TENNESSEE
John M. Dooley & Assoc., 1832 McCalla Ave., Knoxville
Hurston-Conaway, Inc., 2470 Poplar Avenue, Memphis

TEXAS
J. R. Dowdell & Company, 4024 Swiss Avenue, Dallas

UTAH
Williams, Gritton & Wilde, 204 Dooly Bldg., Salt Lake City

VIRGINIA
Shultz and James, Inc., 7 North 6th Street, Richmond

WASHINGTON
Winsor Co., 20031 Marine View Drive S. W., Seattle 66

CANADA
Banton Engineering Specialties,
360 Richmond Road, Ottawa, Ontario
Canwest Industrial Products,
1019—10th Ave. W., Calgary, Alberta
Engineering Equipment Co., Ltd.,
874 Beaumont Ave., Montreal, Que.
Insul-Mastic Corporation, Ltd.,
1400 Spruce St., Winnipeg, Manitoba
Perry Products Ltd.,
528 West 6th Avenue, Vancouver 9, B. C.
Michael Stuart Company, Ltd.,
102 Eglinton Ave. E., Toronto, Ontario

REPORTS from the FIELD

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trical Engineers, Power Rectifier Conference. Morrison Hotel, Chicago, Ill. Details from AIEE, 33 W 39th St, New York 18, N. Y.

June 4-7—Oil-Heat Institute of America, Inc, 1957 Biennial Eastern Exposition of Oil Heat and Domestic Cooling. Hotel Statler, Boston, Mass. Details from Oil-Heat Institute of America, Inc, 500 5th Ave, New York 36, N. Y.

June 9-13—American Society of Mechanical Engineers, semi-annual meeting. Sheraton-Palace Hotel, San Francisco, Calif. Details from ASME, 29 W 39th St, New York 18, N. Y.

June 9-13—International Automation Exposition, 4th International Exposition and Congress. Coliseum, New York, N. Y. Details from IAE, c/o Richard Rimbach Assoc, Management, 845 Ridge Ave, Pittsburgh 12, Pa.

June 10-14—Technical Writer's Institute, 5th annual meeting, Rensselaer Polytechnic Institute. Details from Jay R Gould, Director, Technical Writer's Institute, Troy, N. Y.

June 10-Aug 30 — Gordon Research Conferences for 1957. Held at: Colby Junior College, New London, New Hampshire; New Hampton School, New Hampton, New Hampshire; and Kimball Union Academy, Meriden, New Hampshire. Details from W George Parks, Director, Department of Chemistry, University of Rhode Island, Kingston, R. I. After June 10, address mail to Colby Junior College, New London, New Hampshire.

June 11-14 — Third Western Plant Maintenance and Engineering Show and Conference. Civic Auditorium, San Francisco. Details from Western Office, 759 Monadnock Bldg, San Francisco 5, Calif.

June 16-21 — American Society for Testing Materials, annual meeting. Chalfonte-Haddon Hall, Atlantic City, N. J. Details from ASTM, 1916 Race St, Philadelphia 3, Pa.

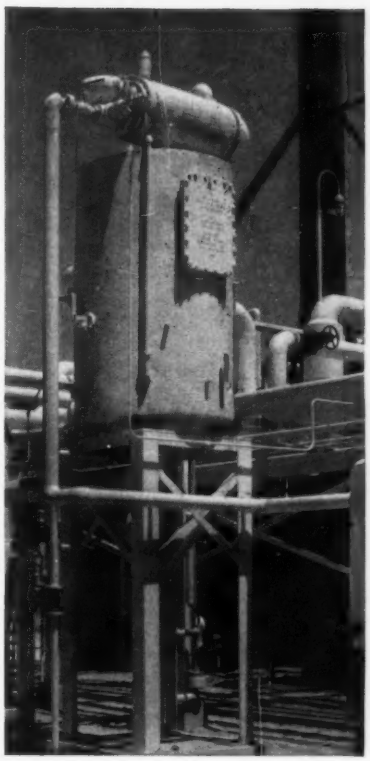
June 16-29—4th Annual Material Handling Training Conference. Industrial Management Center, Lake Placid, N. Y. Details from James R Bright, Industrial Management Center, 56 Robbins Rd, Lexington 73, Mass.

June 17-21—American Society for Engineering Education, 1957 Annual meeting. Cornell University, Ithaca, N. Y. Details from ASEE, University of Illinois, Urbana, Ill.

June 17-21—5th Annual Human Engineering Institute. Stamford, Conn. Details from H E Blank, Jr, Dunlap & Assoc, Inc, 429 Atlantic St, Stamford, Conn.

June 23-28 — National Association of

How to solve a feed water problem



A Texas oil refinery needed a packaged feed water heater rugged enough for exterior installation, and capable of delivering water at specified temperature even with 1" or more of encrustation on tray surfaces. Selected for the job was the Stickle unit shown above. Extra deep trays force water to flow irregularly in a thin film, depositing solids and releasing noncondensable gases. Trays cannot overflow; are easily removed for cleaning. Open coils bring feed water into direct contact with steam, immediately transmit heat to water. Condensed steam is not wasted. It provides one-sixth of boiler feed supply. There's a Stickle feed water heater for practically every need. Capacities 3,000 to 300,000 lbs. per hr. Stickle has built heaters since 1905; is well equipped to solve your feed water problem. Write for free bulletins.

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2265 Valley Ave. • Indianapolis 18, Ind.

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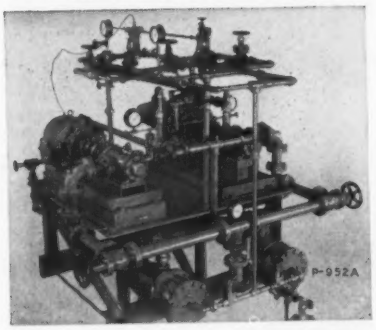
SERVING INDUSTRY'S COMBUSTION REQUIREMENTS FOR 43 YEARS

NATIONAL AIROIL
FUEL OIL PUMPING and HEATING UNITS



P-952A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

Complete range of sizes and models in both medium and high pressure types . . . *more compact than ever!* Write for Bulletin 40.

NATIONAL AIROIL
COMBUSTION ACCESSORIES

AIR CONTROL DOOR and FRAME

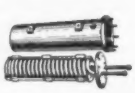
FUEL-OIL SUCTION STRAINER

WIDE VIEW PEEPHOLE

IGNITION PORT

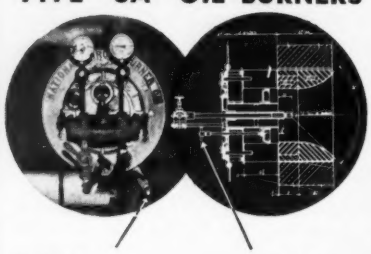
FURNACE RELIEF and ACCESS DOOR

FUEL-OIL HEATER



These and other "accessory items" for every industrial liquid fuel-gas installation. Ask for Brochure No. 10.

NATIONAL AIROIL
UNIVERSAL REGISTERS with TYPE "SA" OIL BURNERS



Control for Air Vane

Control for Refractory Faced Disk

BETTER PERFORMANCE with NATIONAL AIROIL Universal Registers because they have a DUAL FEATURE for controlling air volume independent of turbulence. Air vanes can be instantly reversed to change direction of turbulence while air volume is separately regulated by a refractory faced disc control. Both adjustments can be made while the burner is firing.

Another "dual advantage" of NATIONAL AIROIL Universal Registers is that they are equipped for dual fuel firing of gas and oil. Universal Registers with burners are available in three (3) sizes . . . capacities up to 60,000 lbs. of steam produced per burner per hour. Write for Bulletin 51.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
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INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

REPORTS from the FIELD

Begins on page 154

Power Engineers, 75th National Power Show and Atomic Energy Display. Diamond Jubilee National Convention; Host: Grand Rapids Chapter 16. Pantlind Hotel, Grand Rapids. Details from NAPE, Grand Rapids Chapter 16, PO Box 131, Grand Rapids, Mich.

June 24-28 — American Institute of Electrical Engineers, summer general meeting. Buffalo, N. Y. Details from AIEE, 33 W 39th St, New York 18, N. Y.

July 28-Aug 9—Department of Industrial Management Engineering of Columbia University, 6th Utility Management Workshop. Arden House, Harriman, N. Y. Details from Mrs Rae Wygant, 409 Engineering, Columbia University, New York, N. Y.

American engineering societies form control council

► A NORTH AMERICAN CONTROL council has been formed by a group of technical societies which conduct engineering and scientific activities in the broad field of control systems engineering.

Authorized representatives of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the Institute of Radio Engineers, the Instrument Society of America and the American Institute of Chemical Engineers, meeting at the Western Society of Engineers in Chicago, voted to form the council and framed its two initial objectives:

(1) Cooperation in the organization and operation of a proposed international federation of control systems engineering.

(2) Coordination of the professional activities, meetings, conferences, symposia, and joint control meetings of American Technical societies.

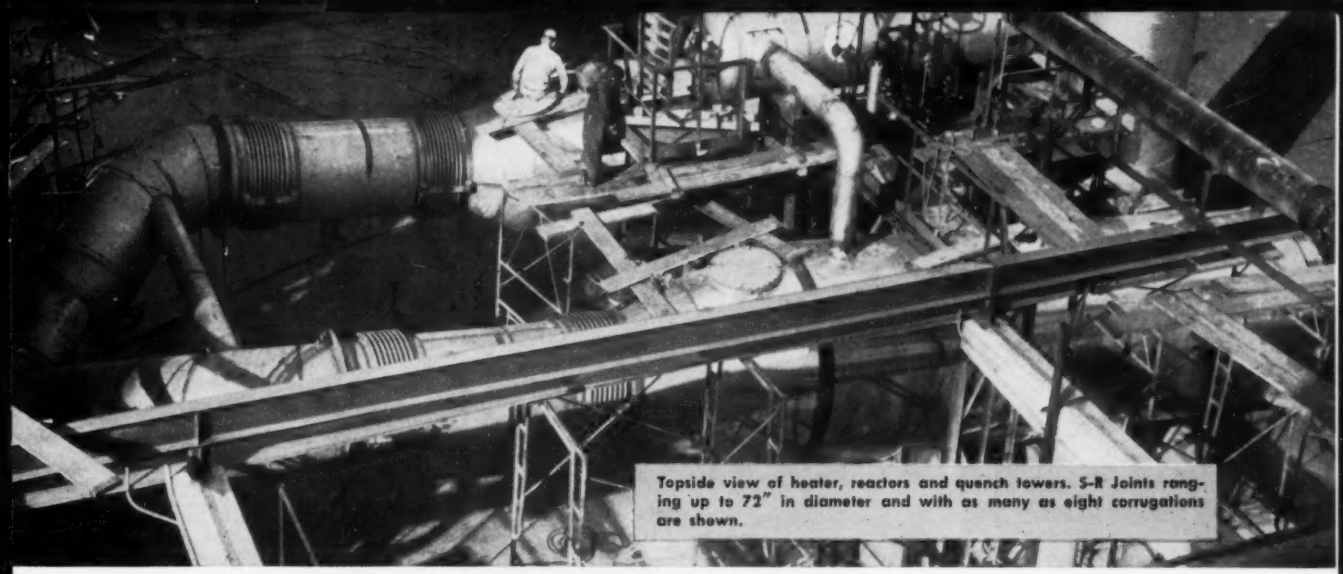
Dr Rufus Oldenburger, Chairman of the Instruments & Regulators Div of the American Society of Mechanical Engineers, was elected chairman.

Allis-Chalmers christens new turbine test pit

► ANNOUNCEMENT COMES from Allis-Chalmers that it has initiated full use of a large new turbine test pit at the West Allis Works.

The new test pit, equipped with steam connections, condenser equipment, lubrication system, and coordinated test instrumentation, is capable of testing units up to and including 250-mw, 3600 rpm.

The pit is a single long opening in



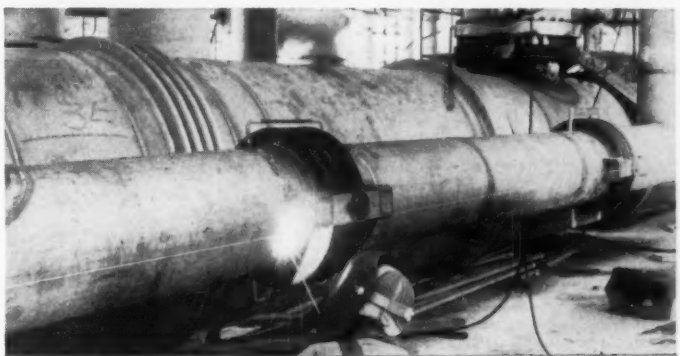
Topside view of heater, reactors and quench towers. S-R Joints ranging up to 72" in diameter and with as many as eight corrugations are shown.

188 Badger Expansion Joints Protect Equipment in Texas Butadiene's New Plant

At the time Texas Butadiene's new plant was designed, engineers figured that the high temperatures required by the process would cause excessive pipe expansion — and possible damage to equipment. They solved this critical operating problem by specifying Badger S-R Expansion Joints — *to absorb and control pipe movement.*

Now — with a total of 188 Badger Expansion Joints in operation (ranging in size from 14" to 72") — Texas Butadiene's new plant at Lyondell, Texas is making processing history. Designed to solve just such exacting expansion problems, the Curvilinear Corrugations and tubular Reinforcing Rings of S-R Expansion Joints insure better equalization and longer cyclic life (see diagrams below).

Size for size, new Badger S-R Joints weigh up to 50% less than conventional types . . . and their new ring design reduces joint diameter. A complete line of accessories — including covers and liners — is available. *Write today for fully illustrated brochure.*



Large line (air in — air out — product out) under reactors includes twelve S-R 48" stainless steel joints to handle temperatures of 1150° F. at 35 psig. Small evacuation line uses fourteen 16-inch S-R Joints.

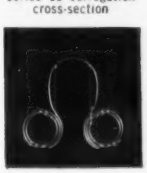
Close up of Regeneration Air Line. This line has fourteen 48" stainless steel S-R Joints handling temperatures over 1000° F.

New corrugation and ring designs produce better equalization, "all-curve" flexing

Curvilinear Corrugations used in S-R Expansion Joints were developed by the Badger Research Department. Under operating pressures (white line) the new design produces more uniform movement per corrugation and natural "all-curve" flexing. Stress is reduced . . . life increased.

Series 50 corrugation cross-section

S-R Joints for higher pressures have tubular Reinforcing Rings. These new rings make metal-to-metal contact only in the "valley" of each corrugation allowing natural "all-curve" flexing (white line). Tubular shape permits greater effective flexing height which contributes to longer joint life.



Series 150 corrugation and ring cross-section

BADGER

S-R

SERVICE RATED

EXPANSION JOINTS

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BADGER MANUFACTURING COMPANY
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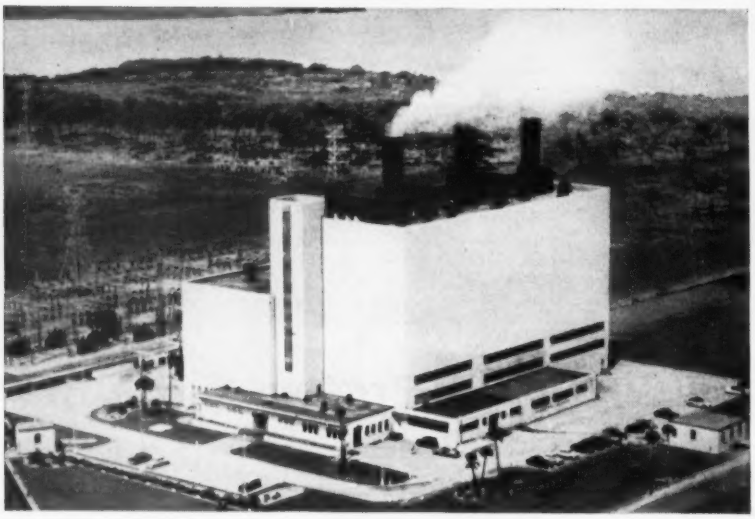
Representatives in Principal Cities

ENGINEERING . . .
makes the difference



Kuljian projects like these are engineered—and custom-built—with a practical knowledge of modern power development. They combine balanced design . . . selection of equipment properly arranged and assembled . . . and are pre-planned to assure maximum flexibility and capacity for meeting the heaviest load requirements. To owners of electric utilities or industrial power plants, Kuljian offers a wide range of power engineering services plus an experience record spanning *twenty-seven years.*

Whether your project calls for engineering only . . . for construction only . . . or for the combined services of engineering *and* construction . . . Kuljian assures you of efficient and economical handling of any phase, from feasibility reports through initial operation.

The Kuljian Corporation

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REPORTS from the FIELD

Begins on page 154

the main assembly area of the plant. It has no internal partitions or permanent platforms, and turbines can be erected on any particular part of it. The floor is a reinforced concrete slab topped by a 12-in. thick, precision-leveled floor-plates. Two 250-mw tandem turbines can be assembled and tested, simultaneously, lengthwise in the pit. When the entire space is not in use, the pit can be shortened by installing heavy concrete and steel slabs on columns to provide additional shop floor space.

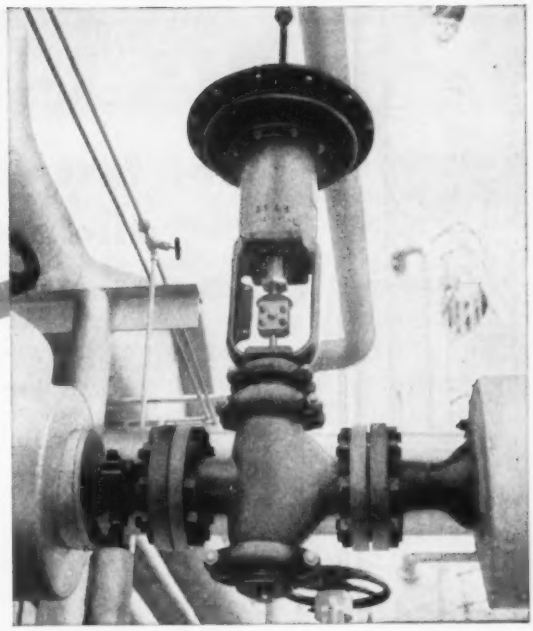
Case Institute selects site for nuclear center

► CASE INSTITUTE of Technology has selected a 275-acre site in Glenwillow Village of Cuyohoga County, 15 miles southeast of Cleveland for the proposed $7 million Case Industrial Nuclear Center. A high-flux engineering test reactor will be the heart of the facility. Designed primarily for advanced industrial research and testing, the reactor will also be used in Case's training and research programs.

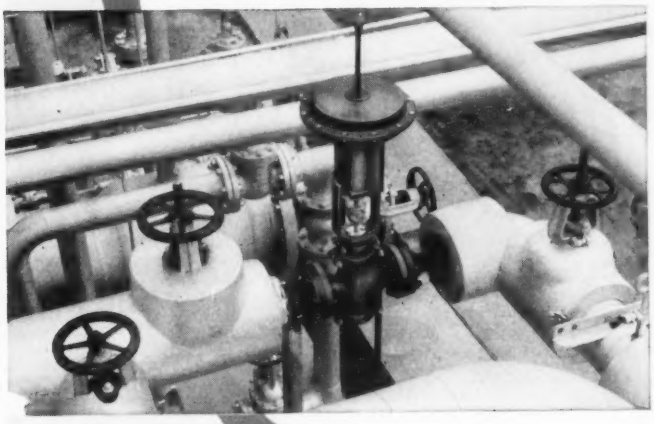
The reactor planned will have a power level of 20,000 thermal kw and a maximum neutron flux of 2x10 neutrons per square centimeter per second. Supporting facilities will include a gamma irradiation center, hot laboratories, radio-chemistry laboratory and a variety of research and testing apparatus.

A number of leading industrial firms already are participating with Case in planning the center and others are expected to join the effort. The Austin Co of Cleveland has been awarded a contract for design and engineering of the center. The Nuclear Products Div of ACF Industries, Inc, is providing preliminary design services for the reactor and related nuclear facilities.

ON STREAM...



BS&B's NEW *Super* 70 *series*



Entirely New Actuator Gives Accurate Linear Response!

- ✓ Choice of direct or reverse acting types in four sizes.
- ✓ Buna-N moulded diaphragm, reinforced with Nylon, gives uniform effective area through full valve travel.
- ✓ Cadmium plated pressed steel diaphragm cases give maximum strength and corrosion resistance with minimum weight.
- ✓ Bolted clamp ring, joining body and actuator, permits yoke to be oriented to any convenient position.

New Valve Body Gives Greater Stability Than Ever!

- ✓ Choice of single port, double port or split body.
- ✓ Streamlined contours provide more stable flow at all inner valve positions.
- ✓ Precision inner valves give more exacting flow characteristics.
- ✓ Patented float ring provides positive self-actuating seal.

EFFICIENCY · OVER 60 YEARS · BS&B · RELIABILITY · ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

For more information on the all-new BS&B Super 70 Series Diaphragm Control Valves, ask your BS&B Sales Engineer—or write for Catalog 70-11.

BLACK, SIVALLS & BRYSON, INC.

Controls Division, Dept. 4-Q6

7500 East 12th Street Kansas City 26, Missouri

This is it...

the fast efficient all-in-one pipe and bolt threader

...threads, cuts, reams!

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500A with SPEED CHUCK

...most clean cuts and threads with least work

Capacity: ⅛" to 2" pipe; ¼" to 2" bolts or rod.

New type wrenchless Speed Chuck operates easily, quickly, guaranteed to grip pipe or rod tightly—forward, reverse; jaws have replaceable insert teeth for longer life . . . Independent die heads, cutter, reamer swing up out of way when not in use . . . Quick-opening die heads—1 Quadri and 2 Dual heads for ¼" to 2" (⅛" available) . . . quick size change right in machine . . . Power for geared tools to 12". Many other efficient worksaver features. See it, try it . . . buy it—at your Supply House.

More for your money RIDGID

Wrenches • Cutters • Vises • Threaders and Power Drives

"Threaded Pipe—*It's Tight—It's Best—Costs Less*"

RIDGID Work-Saver Pipe Tools

The Ridge Tool Company, Elyria, Ohio, U.S.A.

More FREE LITERATURE

Begins on page 169

MAINTENANCE EQUIPMENT

9 **Vacuum cleaning equipment** for boiler cleaning is subject of 4-p bulletin. Covers use of both stationary and portable equipment and points up fuel savings made possible by regular cleaning. Contains illustrations and specs. Spencer Turbine Co, 486 New Park Ave, Hartford, Conn.

10 **Layout of storage facilities,** stock rooms—best heights, aisle spaces, space arrangements for individual items, and how to completely survey requirements—is discussed in illustrated 10-p booklet. Aurora Equipment Co, Equipto Div, Aurora, Ill.

MECHANICAL TRANSMISSION

11 **Industrial gearing** is title of bulletin B-7012. Booklet outlines design facilities and manufacturing capacity of companys' gearing div. Specialized machinery and heat-treating equipment is shown. Includes complete machinery listing. Westinghouse Electric Corp, PO Box 2278, Pittsburgh 30, Pa.

12 **Speed reducers** are described in 24-p illustrated bulletin. Contains dimensional assembly drawings plus complete tables of mechanical and thermal hp ratings, output torque ratings and chain pull ratings for all models. Michigan Tool Co, Cone-Drive Gears Div, 7171 E McNichols Rd, Detroit 12, Mich.

METALS AND ALLOYS

13 **High-strength alloys** for elevated temperature service are described in 20-p illustrated bulletin. Contains engineering properties and fabrication characteristics of ten such alloys. Technical data includes physical constants, mechanical properties at room and elevated temperatures. The Carpenter Steel Co, 3176 West Bern St, Reading, Pa.

14 **Zinc use** and application as a galvanic anode to protect iron and steel from corrosion is subject of two reference manuals. Sixteen-page manual discusses zinc anodes for salt-water applications. Includes tables, charts and drawings. *Zinc as a Galvanic Anode Underground* is title of 40-p manual. American Zinc Institute, Inc, 60 E 42nd St, New York 17, N. Y.

15 **Properties of zirconium** and its alloys is subject of 7-p bibliography. Gives complete and up-to-date source material. Address request to Mr J W Blanton, Columbia-National Corp, 70 Memorial Drive, Cambridge 42, Mass.

METERS AND INSTRUMENTS

16 **Small welding positioners** are subject of 8-p bulletin SU57. Includes illustrations with ap-

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Plant Superintendent, S. L. Gunderson, (left) and operator, Karl Schacht, check operation of the versatile Nordberg 16-cylinder, V-type, 3660 hp Duafuel® engine installed in the Woodstock Light & Power Plant.

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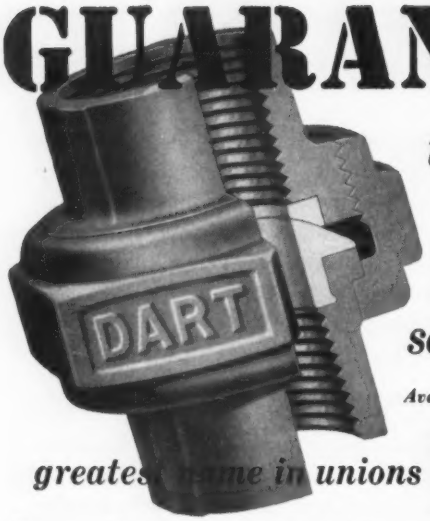

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Begins on page 169

plications, schematic drawings, complete specs and optional accessories. Aronson Machine Co, Main St, Arcade, N. Y.

17 **Three power supplies** in the laboratory instrument line are illustrated and described in 4-p illustrated bulletin. Specs on the three models include input, output, regulation, ripple, size, mounting and weight. Burroughs Corp, Electronic Instruments Div, 1209 Vine St, Philadelphia 7, Pa.

18 **Meter - registers** for industrial liquid metering are discussed in 28-p illustrated bulletin 566. Brochure is arranged in comparative chart form. Accessories, installation directions and application photographs are included. Neptune Meter Co, 19 W 50th St, New York 20, N. Y.

PIPING, VALVES, FITTINGS AND SPECIALTIES

19 **Cushioned float valves** are described in 16-p illustrated bulletin W-5. Contains parts lists, dimensions, approximate shipping weights for the various sizes, operation, installation. Golden-Anderson Valve Specialty Co, 1241 Ridge Ave, Pittsburgh 33, Pa.

20 **Diaphragm control valves,** single- and double-seated, are described in two specification sheets, S810-11 and S810-12. Includes sizes, materials, plug characteristic curves, dimensions, and a cross-section drawing of each type. Minneapolis-Honeywell Regulator Co, Valve Div, Philadelphia 23, Pa.

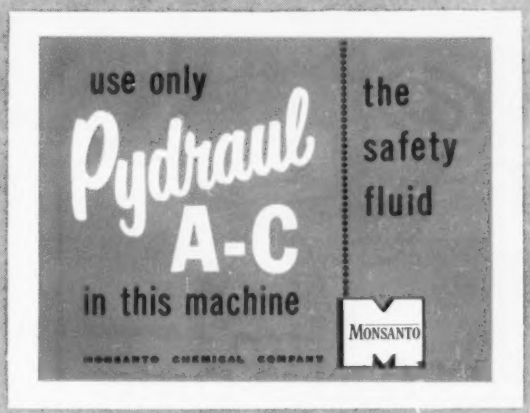
21 **Balanced valve regulators,** *low-pressure,* are described in 12-p illustrated bulletin 1082, Rev 2. Contains a detailed schematic drawing illustrating use, plus specs, dimensions, cut-away drawings and diagrams. Rockwell Manufacturing Co, Meter and Valve Div, 400 N Lexington Ave, Pittsburgh 8, Pa.

22 **Expansion joint** is described in 8-p illustrated bulletin EJ-1915. Gives data on how to figure expansion of pipelines and suggestions for installation of expansion joints. Yarnall - Waring Co, 7700 Norwood Ave, Philadelphia 18, Pa.

23 **Hose, fittings,** socketless kits and self-sealing couplings are described in 11-p illustrated bulletin 182. Includes instructions for ordering, installation planning and assembly of hose and fittings. Aeroquip Corp, 300 S East Ave, Jackson, Mich.

PRIME MOVERS, ACCESSORIES

24 **Industrial engine** is described in 2-p spec sheet. Includes power curves, design details, engineering features and installation drawings



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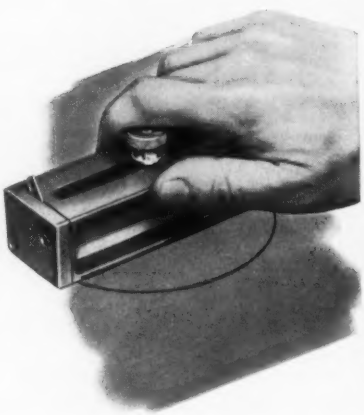

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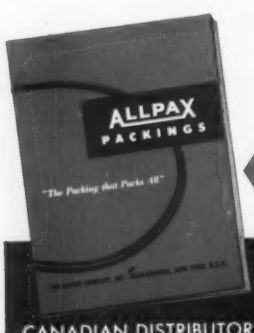

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for the high-torque, heavy-duty *Jeep-6*. Willys Motors, Inc, Industrial Engine Dept, 1445 N Cove Blvd, Toledo, Ohio.

25 **Large steam turbine** advances are discussed in 12-p illustrated bulletin 03R8620. Covers a number of significant developments of interest to the power field. Among the developments portrayed: a new underslung turning gear for units 100-mw and larger. Allis-Chalmers Manufacturing Co, Milwaukee 1, Wis.

26 **Steam turbines**, high-speed multistage, for driving boiler-feed pumps in steam-electric generation stations of 150,000-kw capacity and above, are described in bulletin GEA-6541. Sixteen-page illustrated bulletin contains graphs and cycle arrangements for both condensing and noncondensing turbines. General Electric Co, Schenectady 5, N. Y.

PUMPS

27 **Sewage pumps** for industrial, commercial and domestic use are subject of 12-p illustrated bulletin 7500. Includes performance tables and dimensional drawings, describes standard constructional features. The Deming Company, 42 Broadway, Salem, Ohio.

28 **Power for pumping** is the subject of 12-p power selection handbook DE716. Contains a check list of features necessary for continued dependable operation on pumping jobs. Caterpillar Tractor Co, Peoria, Ill.

29 **Corrosion - resistant pumps** are subject of 20-p illustrated selector manual CE-55. Presents comparative data for four types of pumps. Lists nearly 200 common chemicals and tells which pumps are suitable at room, warm or hot temperatures. Includes capacity charts and specs. American Hard Rubber Co, 93 Worth St, New York 13, N. Y.

WATER TREATMENT

30 **Treatment of water** in air-conditioning systems is discussed in 2-p bulletin ASP-39. Subjects covered include hints on corrosion and scale prevention, problems in chilled water circulating systems, refrigerating plants and control of chemical treatment. Water Service Laboratories, Inc, 423 W 126th St, New York, N. Y.

31 **Purifiers** are subject of 8-p illustrated bulletin 801. Includes buying information and a selection chart showing sizes at various steam flows on different pressures. Also includes section on thermostatic steam traps. The V D Anderson Co, 1935 W 96th St, Cleveland 2, Ohio.

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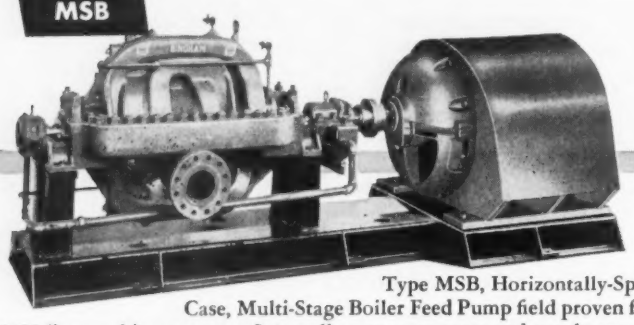

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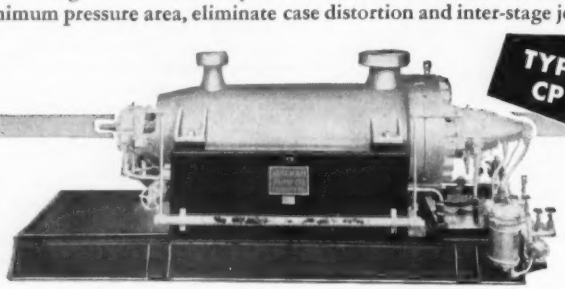

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More TECHNICAL BRIEFS

Begins on page 156

tance at the terminals than machines with a short winding turn length. (3) When the lightning arresters are located at the bus instead of at the machine terminal, more capacitance is required at the machine terminal because of the voltage increase at the capacitor. Where direct close-in strokes are possible, i.e., no overhead ground wire, increase in capacitance required is substantial. (4) Installation of a single standard-sized surge capacitor at the bus feeding several machines will not provide adequate protection for all cases. *AIEE paper No. CP 57-304.*

Advanced design in a small clamp volt-ammeter. *By R F Estoppey, Weston Electrical Instrument Corp.*

The servicing of electrical equipment often requires the measurement of voltage and current for the location of faults and for determining proper operation of the equipment. In recent years, the use of a clamp-volt-ammeter for this type of work has become quite extensive. Toward this end a small, lightweight, dependable clamp-volt-ammeter has been designed having 9 current and voltage ranges on a single scale, taking advantage of new materials and methods for low cost and long life. *AIEE paper No. 56-100.*

Analysis of the shading-coil magnet. *By H J Kubiak, University of Wisconsin.*

The magnetic force of attraction on the armature of a shading-coil magnet varies at double the frequency of the impressed-voltage. A chattering noise begins when an externally applied force, tending to pull the armature away, increases to the point where it is about equal to the minimum value of the variable magnetic force. The main purpose of this paper is to develop a simple method of design that will make the minimum value of the variable magnetic force as large as possible for any given magnet. *AIEE paper No. 56-83.*

The effect of composition on the oxidation stability of electrical oils. *By J L Jezl, A P Stuart, E S Ross, Sun Oil Co.*

A mineral oil in use must give satisfactory performance not only during initial service but also after extended operation. It must possess suitable initial properties and have satisfactory stability toward oxidation.

To determine oil's suitability, the

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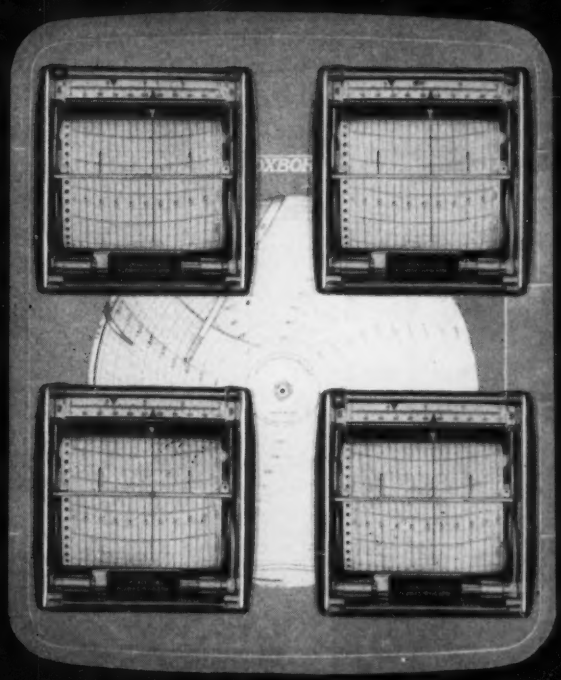

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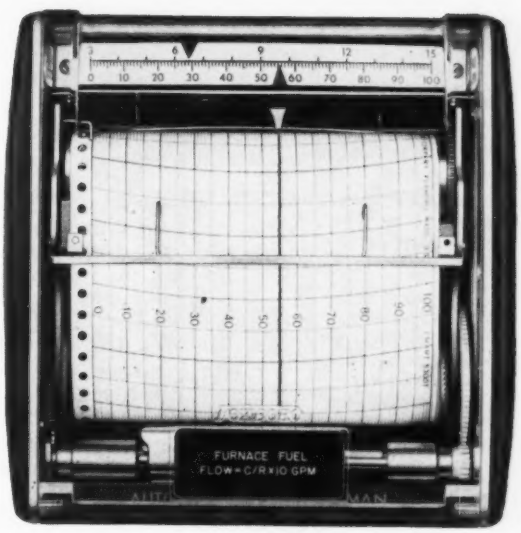

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More TECHNICAL BRIEFS

Begins on page 156

practice has been to apply specific tests to evaluate some critical factor necessary to good performance. In this paper the authors discuss how the chemical composition of the oil affects its performance and in particular its oxidation stability.

The ideal composition of an electrical oil depends on a number of factors. Chiefly, the average molecular weight of the oil and the criteria of excellence considered most important. The authors conclude by considering a major type of electrical oil, such as transformer oil, and showing what constitutes a good oil in today's technology. *AIEE paper No. CP-57-84.*

Direct-current metering of large electrochemical pot-lines. *By M E Reagan, Westinghouse Electric Corp.*

Direct-current metering of large aluminum reduction pot-lines represents a major problem. It is no easy task to get the required degree of accuracy in measuring powers of 100,000-kw dc. Taking advantage of the magnetic core improvement in materials made available by developments during World War II, the magnetic amplifier emerged as a tool for many applications. Among these was a major improvement of the metering accuracies for large electrochemical pot-lines. This paper discusses advantages and reaches some conclusions as to the best fields of application. *AIEE paper No. CP-57-228.*

A magnetic "De-ion" air breaker for 750 mva, 13.8 kv. *By R Frink and J M Kozlovic, Westinghouse Electric Corp.*

Rapid increase in urban load densities in recent years has created an active demand for breakers of more than 500-mva interrupting capacity. Reason: A trend to bring high-voltage power directly to the vicinity of the load center and distribute from there at 13.8 kv. This has resulted in a considerable increase in transformer capacity for this type of application. Substations with 100,000 kva of transformer capacity are being built. Installations of 180,000 kva in transformers have been considered.

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Directions for ordering papers on page 260

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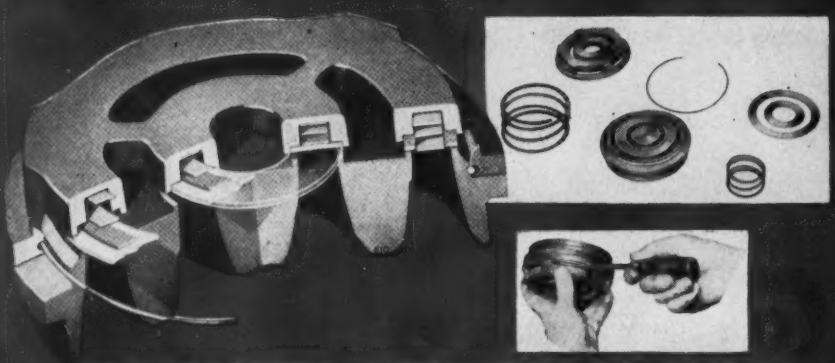

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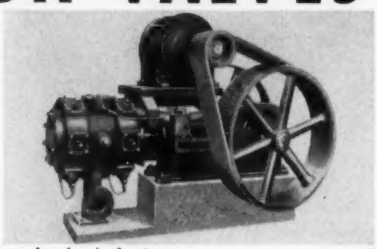

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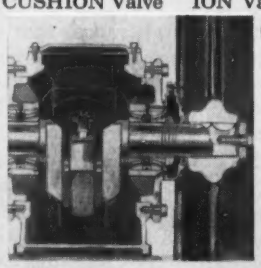

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PENNSYLVANIA PUMP AND COMPRESSOR COMPANY

More TECHNICAL BRIEFS

Begins on page 156

750 mva. Increase in interrupting capacity of 50% over the highest previous standard rating has been accomplished chiefly by new design techniques rather than increase in size. *AIEE paper No. CP-57-225.*

A new 138-kv 10,000-mva air-blast circuit breaker. *By R B Shores and J W Beatty, General Electric Co.*

A new air-blast circuit breaker rated at 138 kv, 1600 amp, 10,000 mva has been developed for outdoor service on the lines of a large metropolitan utility. Designed as individual double-break interrupter units mounted above conventional outdoor current transformers, the several columns of the breaker are mounted on a supporting framework and provided with a central control housing.

Each interrupter is mounted inside its individual air-storage tank for maximum efficiency. The use of porcelain for air tubes or interrupter housings to contain high-pressure air has been avoided to gain high safety factors in design. Dry-air bleed for insulation protection is not required. The breaker is designed to handle a recovery voltage rate of 1000 volts per microsecond at rated current interrupting value. *AIEE paper No. 57-54.*

Gas turbines

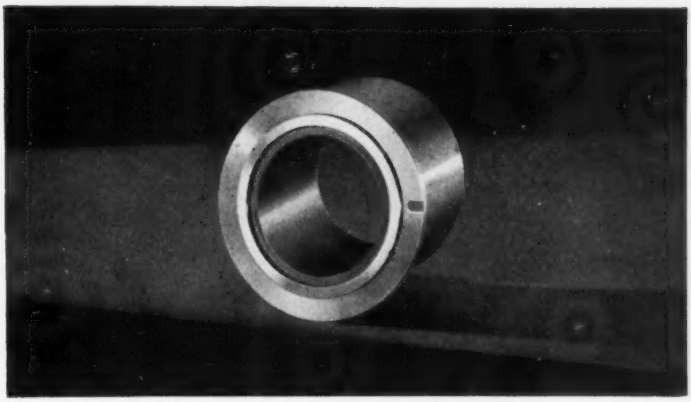
A new concept in engine gas-generator turbine plant. *By R P Ramsey, The Cooper-Bessemer Corp, and S L Soo, Princeton University.*

A new concept in 4-cycle gas generator-turbine plant was suggested including large negative loop in the engine card and the elimination of large or bulky scavenging compressors in contemporary gas generators. Gas can be generated at 200 psi for scavenging-air pressure of two atmospheres.

The 4-cycle high-pressure generator scheme combines high output with the high efficiency of all engine gas-generator schemes, but in the absence of heavy reciprocating masses of free piston engine and the large scavenging compressor of normal centrifugally scavenged gas-generator systems.

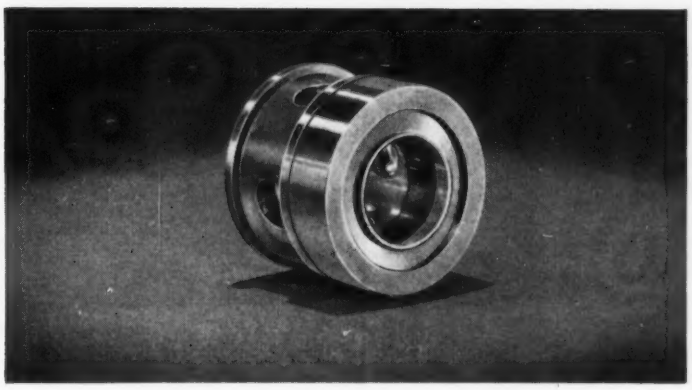
Possibilities of application include centrifugal-compressor drive for natural-gas transmission, pneumatic drive of locomotive with individual gas turbine for each bogie or axle and as a high-pressure gas generator in secondary recovery of petroleum. *ASME paper No. 56-A-204.* (*Continued on page* 258)

Directions for ordering papers on page 260

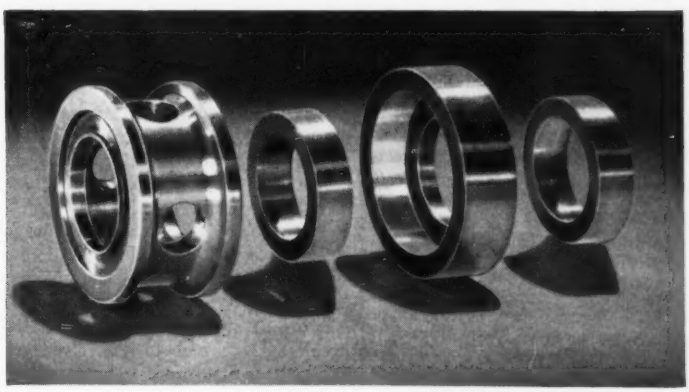


SINGLE BUSHING TYPE Floating Ring Seal

Seal Any Medium—Even Corrosive Media . . . with Koppers Floating Ring Seal



MULTIPLE RING TYPE Floating Ring Seal (assembled)



FLOATING RING SEAL Basic Elements: Lantern Ring, Floating Ring, and Spacer Diaphragm. As sealing needs dictate, floating rings and spacer diaphragms are added. Seals are carbon, plastics, ceramics or steel, as applications require.

The Only "No Maintenance" Seal for Rotating, Oscillating and Reciprocating Motion

Koppers' precise, efficient Floating Ring Seal assures long seal life, low leakage, reduced wear, less power consumption, and decreased operating costs.

It seals at high temperatures and at pressures up to, and for some conditions even above, 2000 psi. Inspection has shown that after 10,000 hours of operation, ring and spindle wear can be negligible. For water at 500° F. and 1200 psig with a $\frac{5}{8}$" spindle, leakage is only one to two pounds per hour. Frictional power requirements are virtually zero, and Koppers' design reduces radial frictional restraint. Sealing members adapt to changes in the shaft's position.

Applicable to valve spindles, pumps, atomic reactor spindles and many other similar installations, Koppers Floating Ring Seal gives efficient, low-cost service for the sealing of all types of fluids under widely varying conditions of temperature and pressure.

For additional information, write to: KOPPERS COMPANY, INC., Piston Ring and Seal Department, 2106 Hamburg Street, Baltimore 3, Maryland.

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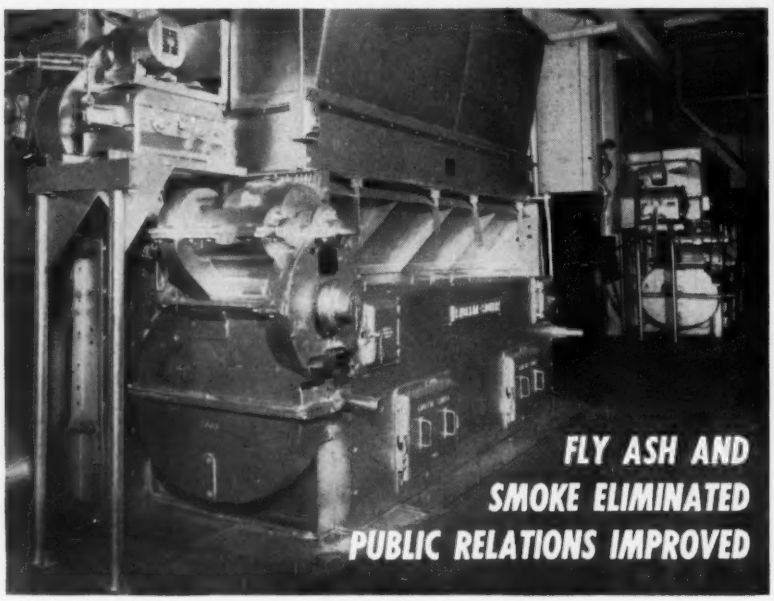
MECHANICAL SHAFT SEALS

Engineered Products sold with *Service*

10% GREATER EFFICIENCY at THE TRANE COMPANY with LACLEDE STOKER



Two Laclede Chain Grate Stokers recently installed by The Trane Company.

The Trane Company, La Crosse, Wisconsin, one of the largest manufacturers of air conditioning equipment, recently replaced a spreader stoker with a Laclede Chain Grate Stoker under an existing boiler. This replacement was made, primarily, in order to reduce the smoke and fly ash nuisance of the unit, which had become a public relations problem in the neighborhood.

Since making the change, they have had no smoke or fly ash problem with this boiler with loads varying from 30% to 200% of the boiler rating.

In addition to improving public relations, evaporation figures show that the evaporation per pound of coal has been increased approximately ten percent.

Because of this excellent performance, a second Laclede Chain Grate Stoker has been installed under a new boiler by The Trane Company.

FOUNDED IN 1904

LACLEDE
STOKER COMPANY
4440 HUNT AVE. • ST. LOUIS 10, MO.

More TECHNICAL BRIEFS

Begins on page 156

Pressure drop and air flow distribution in gas-turbine combustors. *By J S Grobman and R T Dittrich, Lewis Flight Propulsion Laboratory.*

Generalized curves showing the combustor total pressure loss coefficient and air flow distribution for various geometric configurations and operating conditions were obtained from theoretical calculations. The results pertain to tubular turbojet combustors having (1) constant annulus and liner cross-sectional areas along the combustor axis and (2) flush circular holes in the liner walls. *ASME paper No. 56-A-208.*

Research on application of cooling to gas turbines. *By J B Esgar, J N B Livingood and R O Hickel, Lewis Flight Propulsion Laboratory.*

Use of turbine cooling in gas-turbine engines can offer many performance benefits but, at the same time, it may result in added complication to the engine. Advantages that turbine cooling can offer to the engine designer and results of some of the research that has been expended on the cooling of gas-turbine engines are discussed. *ASME paper No. 56-SA-54.*

Free-piston engines and compressors—bibliography. *By J A Scanlan, University of Texas, and B H Jennings, Northwestern University.*

Much material has appeared on free-piston engines, but the literature is widely scattered. Consequently the authors felt that the current growing interest in free-piston engines could best be served by bringing all pertinent references together in a single listing. This bibliography covers a literature search from 1927 to 1956. *ASME paper No. 56-A-23.*

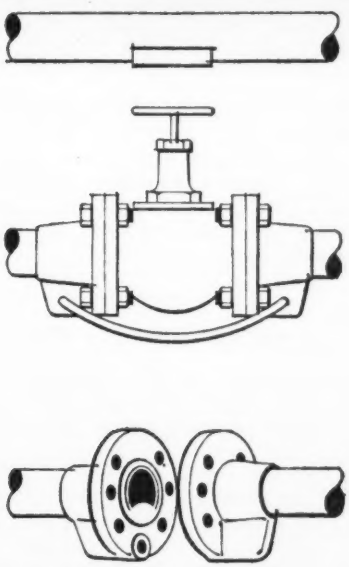
French experience with free-piston gasifiers. *By M Barthalon, Societe Industrielle Generale De Mecanique Appliquee and H Horgen, Societe d'Etudes Mecaniques et Energetiques.*

This paper is a factual account of six years of field development and operation of SIGMA free-piston gasifiers. It first surveys existing sets, then summarizes development and exploitation problems that had to be solved and finally presents future trends.

As a result of the industrial success of the original SIGMA gasifiers, the paper studies a combined steam-and-gas power plant that, for the first time, combines the four basic elements (steam and gas as working fluids, pis-

Directions for ordering papers on page 260

With this new round shape, UNITRACE costs substantially less per foot. And since the steam passage has less outside wall area, external radiation heat loss is reduced. The need for thermal insulation is often eliminated. When insulation is used, it costs less because standard pre-formed pipe covering can be used.
to cut costs,
boost efficiency
of steam traced pipe...
ALCOA UNITRACE has a NEW SHAPE
for lower cost per foot...
easier joining...
less heat loss...better
internal heat transfer



Sections of UNITRACE in the new shape can be easily and quickly joined by the weld and patch method (top). And a brand new UNITRACE flange—with product and steam passages cast as integral parts of the flange—simplifies installation of valves (center) and other flanged connections (bottom).

Want to save money on steam-traced piping? Here's good news for your pocketbook! ALCOA® UNITRACE *has a new cost-cutting shape* . . . a round section matching standard pipe shapes . . . available in 1½", 2", 3" and 4" sizes.

With steam and product passages extruded in a single unit of light, strong, corrosion-resistant Alcoa aluminum alloy 3003-F, UNITRACE completely eliminates the cost of external steam jackets or tracer tubes. And the new UNITRACE shape makes possible these *extra* savings:

Lower cost per foot . . . total volume of metal is less; material costs are lower.

Easier, faster joining . . . new configuration (with exterior grooves for quick steam passage identification) makes mating and joining fast and simple to cut installation costs.

Less external heat loss . . . improved internal heat transfer . . . the new design reduces area for external radiation loss.

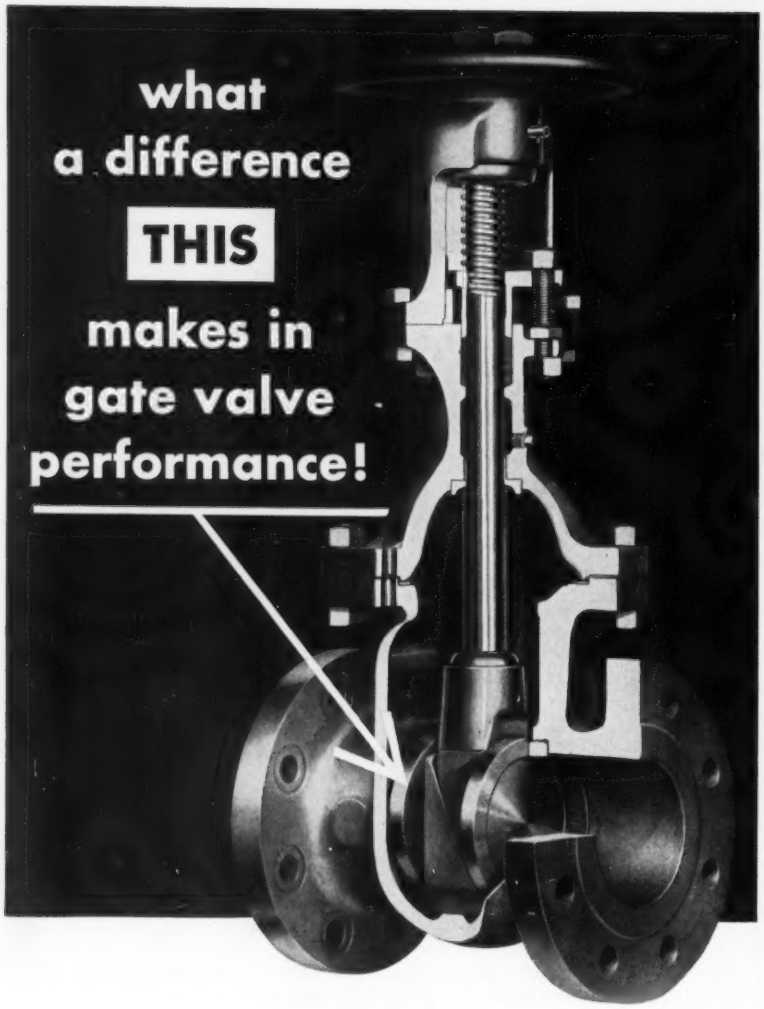
The natural corrosion resistance of aluminum makes UNITRACE ideal for handling naval stores, molten sulfur, ammonium nitrate solutions, glacial acetic acid, fatty acids, tar, pitch, wax, urea and similar products which normally require heated transfer lines.

Find out today how *you* can use ALCOA UNITRACE to cut costs and improve efficiency of your heated transfer lines. Call your nearest Alcoa sales office, or write Aluminum Company of America, 888-F Alcoa Building, Pittsburgh 19, Pennsylvania.

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

Write for this FREE BOOKLET!
This new, illustrated booklet contains complete engineering, specification and fabrication data on ALCOA UNITRACE in the new shape. It's your guide to low cost heated transfer lines. Write for it today!



LONGER valve life, less maintenance and process interruption, positive closure, easier operation, self-adjustment for valve body deflection. These are some of the well proved advantages gained as a result of the Darling *fully revolving double disc parallel seat* principle!

These Darling valves are made in various alloys, types and sizes for most services . . . and for all pressures. Send for Catalog No. 57. You'll see what we mean by exceptional performance.

ENGINEERING SERVICE: Darling offers unusual facilities for the development and manufacture of special valves for out-of-the-ordinary requirements. This special service is available to you at all times, without obligation.

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Williamsport 8, Pa.
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Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

DARLING
TRADE DARLING MARK
VALVES

More TECHNICAL BRIEFS

Begins on page 156

ton rod assembly and turbine blade and shaft for converting heat into mechanical power) into an efficient power plant in the range from 20,000 to 100,000 kw. *ASME paper No. 56-A-209.*

Standards

Are standards or codes practical for ultrasonic examinations of metals and weldments? *By F C Parker, Union Carbide & Carbon Chemicals Co.*

A few examples of pressure-vessel and machinery failures resulting from inadequate inspection of new materials and welding are presented. The paper illustrates service failures that can be prevented by periodic ultrasonic examination. It also shows how ultrasonics enable us to learn more about subsurface and otherwise inaccessible areas in a very economical manner.

The author concludes by emphasizing the need for reasonable standards that will accept materials manufactured only to a functional quality. In ultrasonic work there are, at present, no flaw-limit standards and no code. It's the author's belief that such standards can be developed. *ASME paper No. 56-A-185.*

Proposed standards in preparation.
ASA Proposed American Drafting Standards Manual Section 14—Structural Drafting, Y14.

Proposed American Standard, Graphical Symbols for Fluid Power Diagrams, ASA Y32.

Proposed American Standard, National Miniature Screw Threads, ASA B1.4.

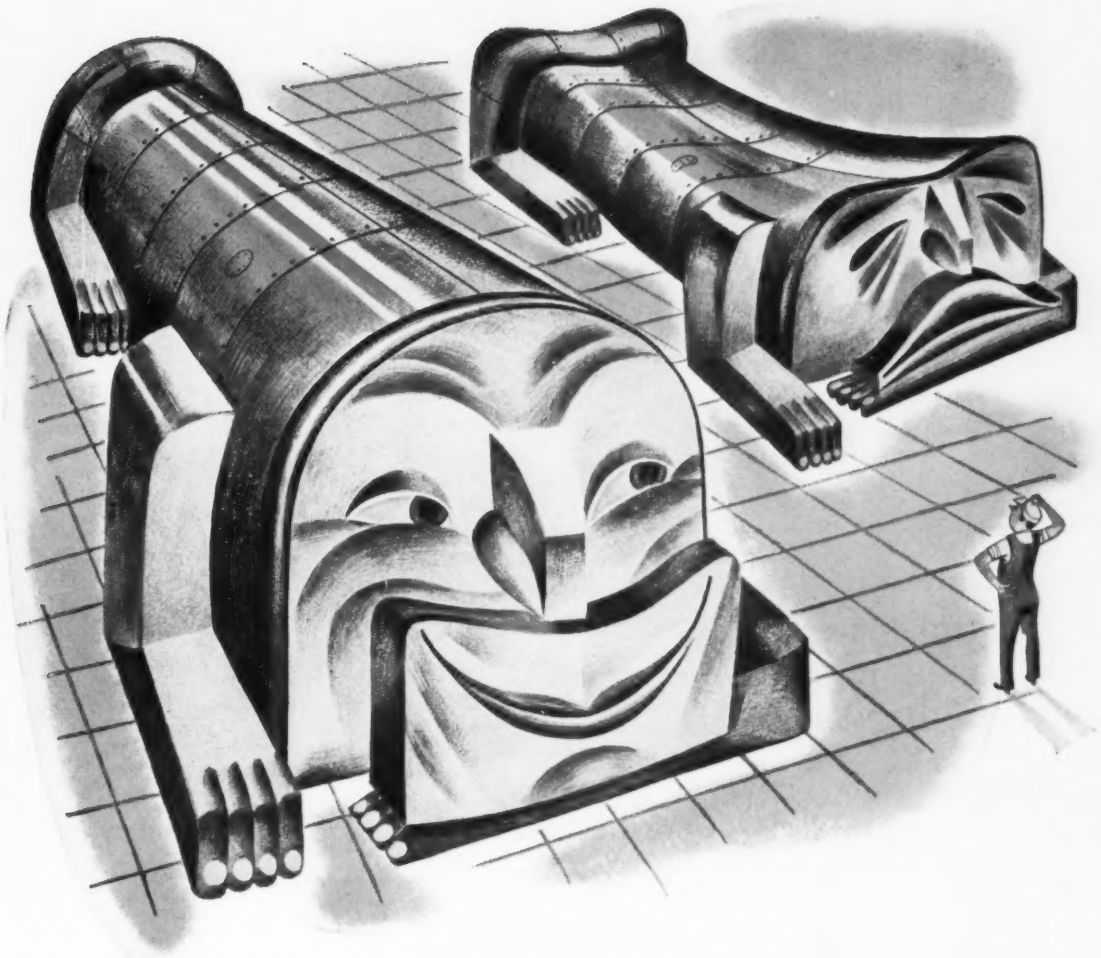
Interested parties may obtain copies of the tentative drafts of these proposed standards by addressing Frank Philippbar, Standards Dept, ASME, 29 West 39th St, New York 18, N. Y.

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, New York.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, New York.



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The Correct Turbine Oil can make the difference

The tremendous investment any turbine represents is a mighty powerful reason for using Cities Service Turbine Oils.

For Cities Service "Pacemaker-T" Turbine Oils provide unsurpassed anti-foam and anti-rust protection, plus maximum oxidation stability and water separation . . . factors that keep your equipment generating without degenerating.

Moreover, there's a Cities Service Turbine Oil with the precise viscosity and makeup for every type of turbine, every type of oiling system and every type of operating condition.

Get the details from the Cities Service Lubrication Engineer at the nearest Cities Service office. Or write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

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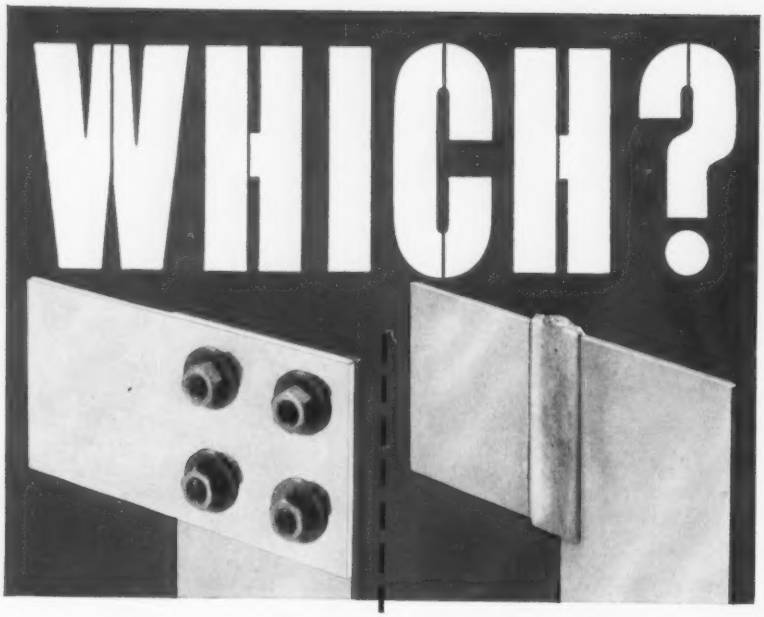

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APPOINTMENTS

Corporation executive changes

Worthington Corporation: Walther H Feldmann, president; Edwin J Schwanhausser, vice-chairman. **The Hays Corporation:** Philip A Sprague, president; Donald R Schoen, executive vice-president. **Keasbey & Mattison Co:** Robert R Porter, president. **Sylvania-Corning Nuclear Corp:** W Benton Harrison, chairman; Lee L Davenport, president and treasurer; Walter E Kingston, executive vice-president. **Infilco Inc:** P N Engel, chairman; J S Gustafson, president, **Mexico Refractories Co:** W Basil Leach, president; John B Arthur, chairman and chief executive officer; C A Smith, vice-president and chief engineer; Carl H Bachmann, vice-president.

Public Service Electric and Gas Co: Watson F Tait Jr, executive vice-president; Edwin H Snyder, vice-president, electric operation. **Texas Gas Transmission Corp:** W M Elmer, executive vice-president. **Iron Fireman Manufacturing Co:** Lewis J Cox, 1st vice-president and chief executive officer; R K Handley, vice-president. **Illinois Gear & Machine Co:** E C Wilson, vice-president.

The Garlock Packing Co: Donald F Fraser, vice-president, manufacturing; Albert J McMullen, vice-president. **The Dayton Power and Light Co:** Kenneth G Oxley, vice-president, electric operations; Edward J Rommel, vice-president, commercial division; Josiah V Colley, vice-president. **Walworth Company:** William M Combs, vice-president, Gulf division. **American Gilsonite Company:** Roy E Nelson, vice-president.

Engineer changes

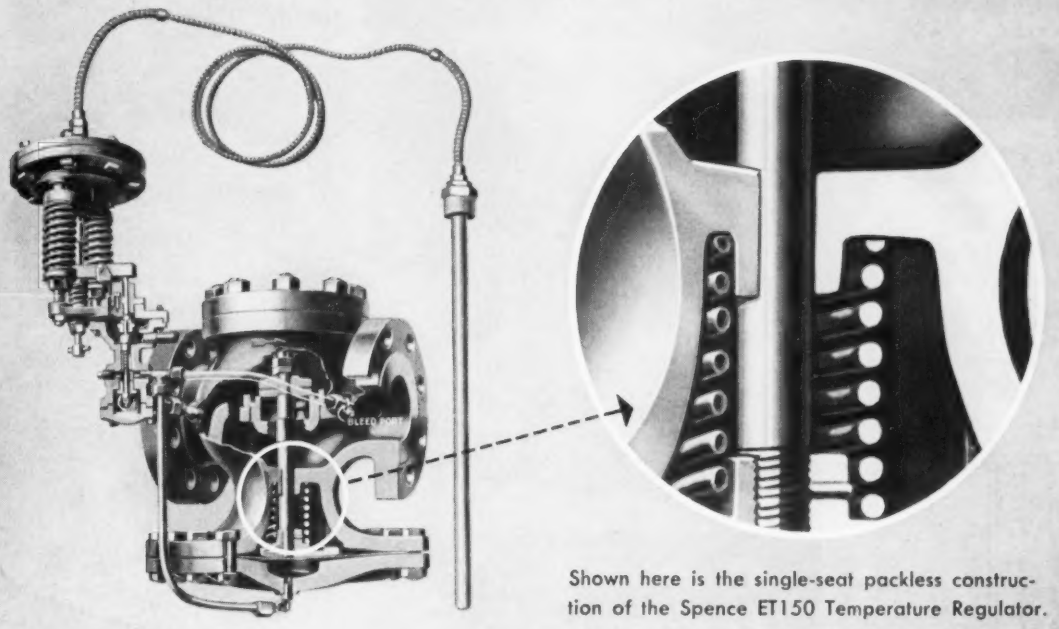
National Research Corp: Milo P Hnilicka, engineering associate. **The Trane Company:** John Kennedy, manager of industrial engineering dept. **Sterling Engine Company:** Richard L Gates, chief engineer. **Fairbanks, Morse & Co:** R K Annis, development engineer. **Allis-Chalmers Manufacturing Co:** E P Hansen, asst chief engineer, steam turbine dept. **Gulf States Paper Co:** Archie Colby, industrial engineer. **J B Rea Company:** Sam Philips, applications engineer.

New representatives

For **Carrier Corporation:** Norman S Wright Co, Phoenix, Ariz., and McMillan Equipment Co, Houston, Texas. For **Robertshaw-Fulton Controls Co,** Fielden Instrument division: Nickles Engineering Co, 830 Linden Ave, Rochester 10, N. Y. For **J F Pritchard & Co:** Steel & Engineering Products Co, El Paso, Texas. For **Graver Water Conditioning Co:** Taylor En-

VALVE TIPS:

Advantages of Packless Construction in Temperature Regulating Valves



Shown here is the single-seat packless construction of the Spence ET150 Temperature Regulator.

One of the biggest headaches in regulating valve maintenance is repacking stuffing boxes.

How often a valve needs repacking, how much time it takes, and the cost of the system downtime all vary with the construction of the regulator and the service it's used for. No matter how you calculate all these variables it's still a headache—and an expensive one.

In the temperature regulator shown above (Spence Type ET150) stuffing boxes are eliminated. This is done by what is known as "balanced" diaphragm construction. You can see in the cutaway drawing that pressure is applied to both sides of the large metal diaphragm. The upper side is exposed to delivery steam pressure and the lower side is exposed to loading pressure applied by the pilot. When the pilot closes, both delivery pressure and loading pressure are equalized through the bleedport and connecting tubing.

This construction not only does away with repacking problems, but it makes possible additional savings as well. For example, you will note in the sectional blow-up that this design eliminates a closely fitted stem and guide. Dirt or other foreign matter doesn't have much of a chance to lodge between these parts and cause sticking.

Another cause of binding or sticking, uneven expansion of closely fitted parts, is also eliminated with this design. In addition, valve stem wear is reduced for the same reason.

Lower maintenance is not the only advantage of this packless construction. Accuracy of regulation is also improved because friction due to a stuffing box, dirt, or uneven expansion is not a problem. The large, *balanced* metal diaphragm is more sensitive to slight changes in pressure.

Guaranteed Not To Wiredraw

If seats and discs are cut by steam (wiredrawn) the loss of steam through these grooves can be another expensive item — directly charged against the regulating valve. Fortunately, you can eliminate these costly leaks by specifying a temperature regulator that is *guaranteed not to wiredraw.*

Spence makes such a guarantee because their seats and discs are made of SECO Metal. Over 20 years experience with this special alloy has failed to produce a single case where a SECO Metal seat or disc had been cut by steam. All that's required is an approved strainer located ahead of the regulating valve. Expensive steam leaks just can't happen with this combination of SECO Metal and single-seat design.

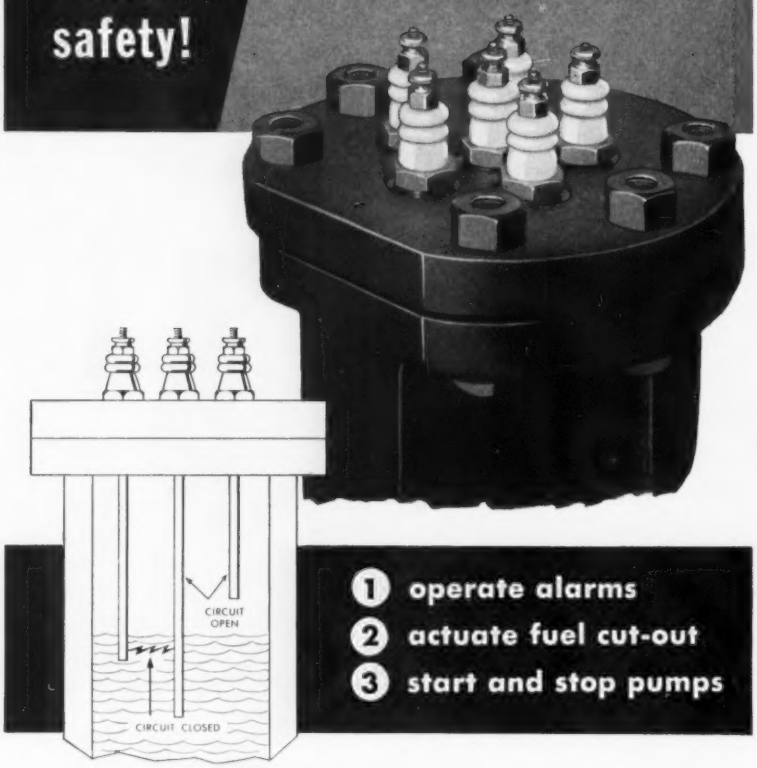
If you would like to have more information on Spence Temperature Regulators, drop us a line and ask for Bulletin T150. It gives more detailed information on these and other Spence design features. Piping layouts and helpful information on the installation of temperature regulators are also included. Write for your copy today.

SPENCE ENGINEERING COMPANY, INC.
Walden, New York

SE 140

Tiny currents guard boiler safety!

Reliance electrode-type Levalarms®



1 operate alarms
2 actuate fuel cut-out
3 start and stop pumps

For extra safety, guard your boiler water levels with audible and visible alarms that reach operators anywhere in the plant. Or cut fuel automatically, without depending on human action. Here's more protection for boilers working on any pressure to 2500 lbs.

Levalarms operate on isolated electric currents passing through the boiler water itself. When water level gets too high or too low, circuits are made or broken and actuate relays *instantly* to cause ACTION (1, 2, or 3 above).

Four models of Levalarms installed on or in your water columns, provide a selection for various control combinations. Levalarms have no bellows or stuffing boxes; no vacuum tubes or magnets. Action is positive, immediate. Levalarms are unaffected by pressure, temperature or water conditions.

Read the full story of Reliance electrode-type Levalarms in Bulletin D2 sent on request.

The Reliance Gauge Column Company • 5902 Carnegie Avenue • Cleveland 3, Ohio

The name that introduced safety water columns....in 1884

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BOILER SAFETY DEVICES

More APPOINTMENTS

Begins on page 262

gineering & Construction Co, Ltd, 111 Stephenson Ave, Toronto 13, Ontario, Can. For **Thermal Research & Engineering Corp:** W G Barstow Co, 6800 W Lake St, Minneapolis, Minn., and Hester Engineering, 2332 5th St N, St. Petersburg, Fla.

For **Zurn Industries, Inc,** American Flexible Coupling division: Mark-Costello Co, 6511 Whittier Blvd, Los Angeles, Calif.; Ken Smith Co, PO Box 6104, Phoenix, Ariz.; F Somers Peterson Co, 157 13th St, San Francisco, Calif.; J M Warner Co, 600 W 48th Ave, Denver, Colo.; and Sales Engineering Co, 526 W 8th South St, Salt Lake City, Utah.

New distributors

For **The Formsprag Company:** Allied Companies, Inc, Atlanta, Ga. For **Hills-McCanna Company:** The Laidlaw Company, 1606 N Illinois St, Indianapolis 2, Ind. For **Parker Appliance Co:** Franchisement of Bearing Sales & Service, Inc, 1645 NW Hoyt St, Portland 9, Ore., and 2906 6th Ave S, Seattle 4, Wash. For **Ampco Metal, Inc:** Oxygen Service Co, 349 Market St, Kingsport, Tenn.

New sales managers

Burgess-Manning Company: W A Carroll Jr, industrial silencer division. **The Briggs Filtration Company:** John D MacGuffin. **H K Porter Co, Inc:** E M Richardson, refractories division. **U.S. Gauge Division,** American Machine and Metals, Inc: Joseph A E Hindman. **Olin Mathieson Chemical Corp:** W Adrian King, industrial chemicals division.

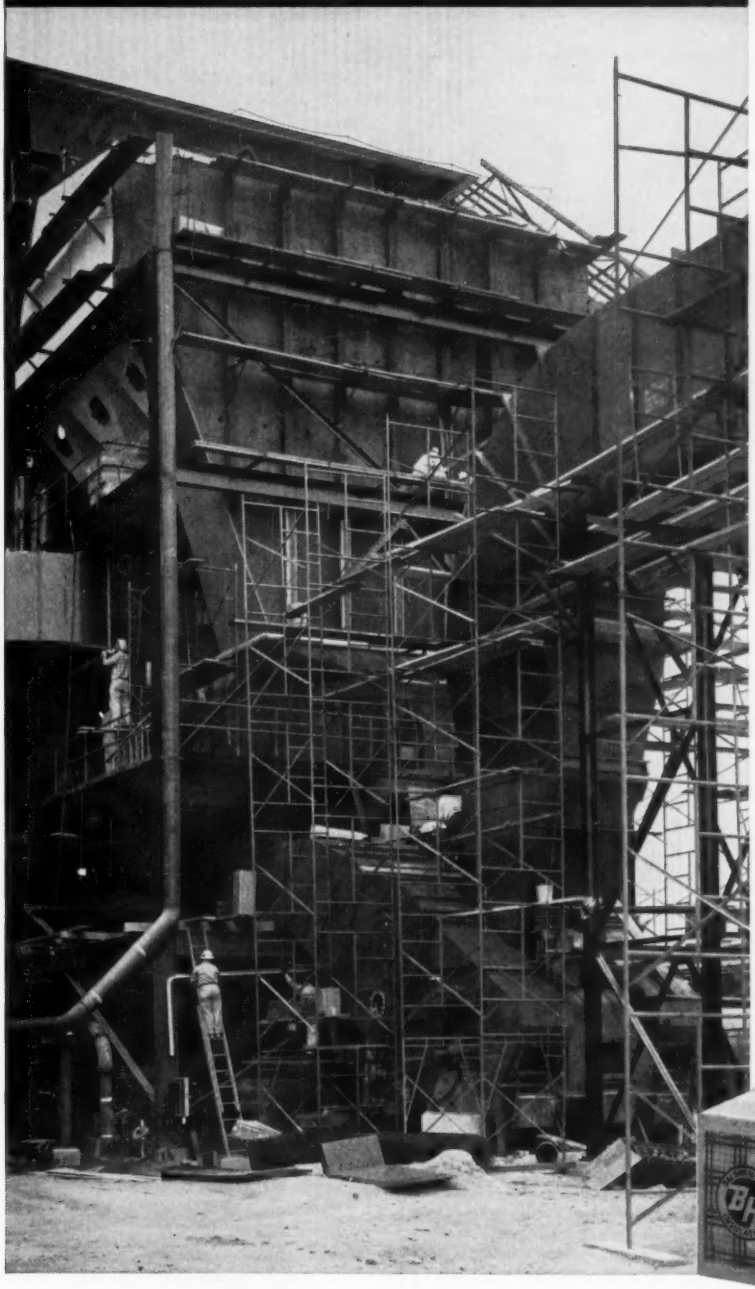
New district managers

U.S. Rubber Co, mechanical goods division: William J Reddington, St. Louis district. **The H M Harper Company:** Roderick Martin Jr, Florida district. **Rockwell Manufacturing Co,** meter and valve division: Charles J Kentler Jr, New York district; Charles B Goff Jr, Pittsburgh district. **A O Smith Corp:** A C Persson, central district, pressure vessels and heat exchangers. **Gould-National Batteries, Inc,** industrial division: S V Malin, Detroit district. **Clark Bros Co:** Arthur N Haar, western region, industrial sales. **Research-Cottrell, Inc:** Hugh D O'Rourke, Chicago district.

New sales engineers

Milton Roy Company: Alfred E Mohan, 1266 S Newkirk St, Philadelphia, Pa. **Darling Valve & Manufacturing Co:** Robert C Gaynor, Toledo office. **Edward Valves, Inc:** Roger O Bachman, Denver area. **Robertshaw-**

500,000 lb. per hr. BOILERS at New DELAWARE CITY STATION



Standardization and Simplification cut installed cost using

BALDWIN-HILL MONO-BLOCK

By standardizing on B-H MONO-BLOCK, Riley Stoker Corp. effected low installed cost, faster application and obtained top thermal efficiency on three boilers in the first plant designed to burn fluid coke as a primary fuel.

MONO-BLOCK, made of spun mineral wool, is effective over the full temperature range to 1700° F. It was used to cover all flat and large curved surfaces of boiler walls, accessory housings and ducts. Light in weight, rigid and easy to handle, MONO-BLOCK is quickly applied.

Baldwin-Hill SUPER POWER-HOUSE CEMENT was used to point all joints and as a one-coat insulating-finishing cement.

See our catalog in Sweet's Plant Engineering File.

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For the full report on this economical installation, just staple the keyed corner of this ad to your letterhead and mail.

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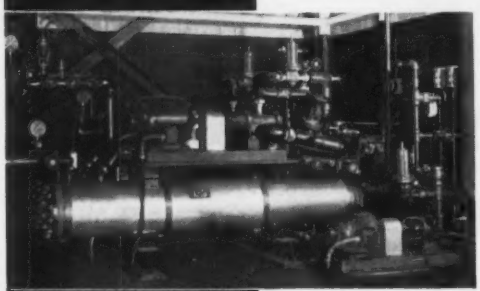
For heavy bunker oil or light furnace oil...100 to 10,000 gallons per hour

Enco systems employ one, two or more pumps and heaters, interconnected so that full capacity is possible with any combination of pumps and heaters. Flexibility of design permits the use of any combination of rotary pumps, with motor or turbine drive; or piston type steam pumps. Any part may be cut out of operation for inspection or cleaning, without shutting down, where two or more pumps and heaters are included in the unit system.



Heaters are insulated and jacketed with removable heads at both ends for cleaning without breaking any piping connections or removing any tube bundles.

Full automatic oil pressure and temperature control, with relief valves for each pump and heater. Permits delivery of oil with safety, and at proper temperature and pressure for efficient burning.

Each unit is built to order and delivered ready to place on foundation and for connection to the station piping.

Write for Bulletin OB-53 describing Enco Gas and Oil Burners; and Pumping and Heating Equipment.

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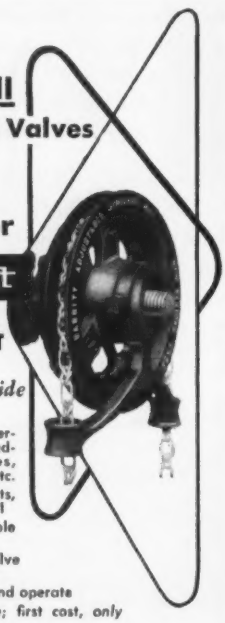
REACH for Babbitt

Adjustable **SPROCKET RIM** *with Chain Guide*



- Eliminate dangerous catwalks, ladders, balconies, boxes, stools, etc.
- Prevent accidents, protect personnel
- Reach inaccessible areas easily
- Operate every valve from plant floor
- Easy to install and operate
- No maintenance; first cost, *only* cost
- Easy instructions with each unit
- Packed, completely assembled, one to a carton
- Fits any size valve wheel
- Your supplier carries complete stock
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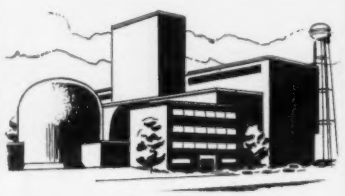

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More APPOINTMENTS

Begins on page 262

Fulton Controls Co, Fulton Sylphon division: James D Crum, Baltimore office. **Parker Appliance Co,** rubber products division: Norman G Burkhardt, San Francisco district.

Recent purchases, mergers

American Gage and Machine Company: purchase of Standard Transformer Company. **A P Green Fire Brick Company:** acquisition of the Richard C Remmey Son Company. **Ling Industries, Inc:** purchase of Electronic Wire & Cable Company. **Beckman Instruments, Inc** and **Statham Laboratories, Inc** to merge, subject to completion of legal details and approval of shareholders.

York Shipley, Inc: Humble-Mundis Co has merged with two divisions of parent company. New Shipley-Humble division replaces the former Shipley-Roosevelt Oil Service and Shipley Cooling and Heating Service division.

Consolidated Diesel Electric Corp: acquisition by a wholly-owned subsidiary of the business and assets of The Lima Electric Motor Company. **H K Porter Co, Inc:** acquisition of Federal Wire & Cable Company, Ltd by H K Porter Co, Ltd, a wholly-owned Porter subsidiary.

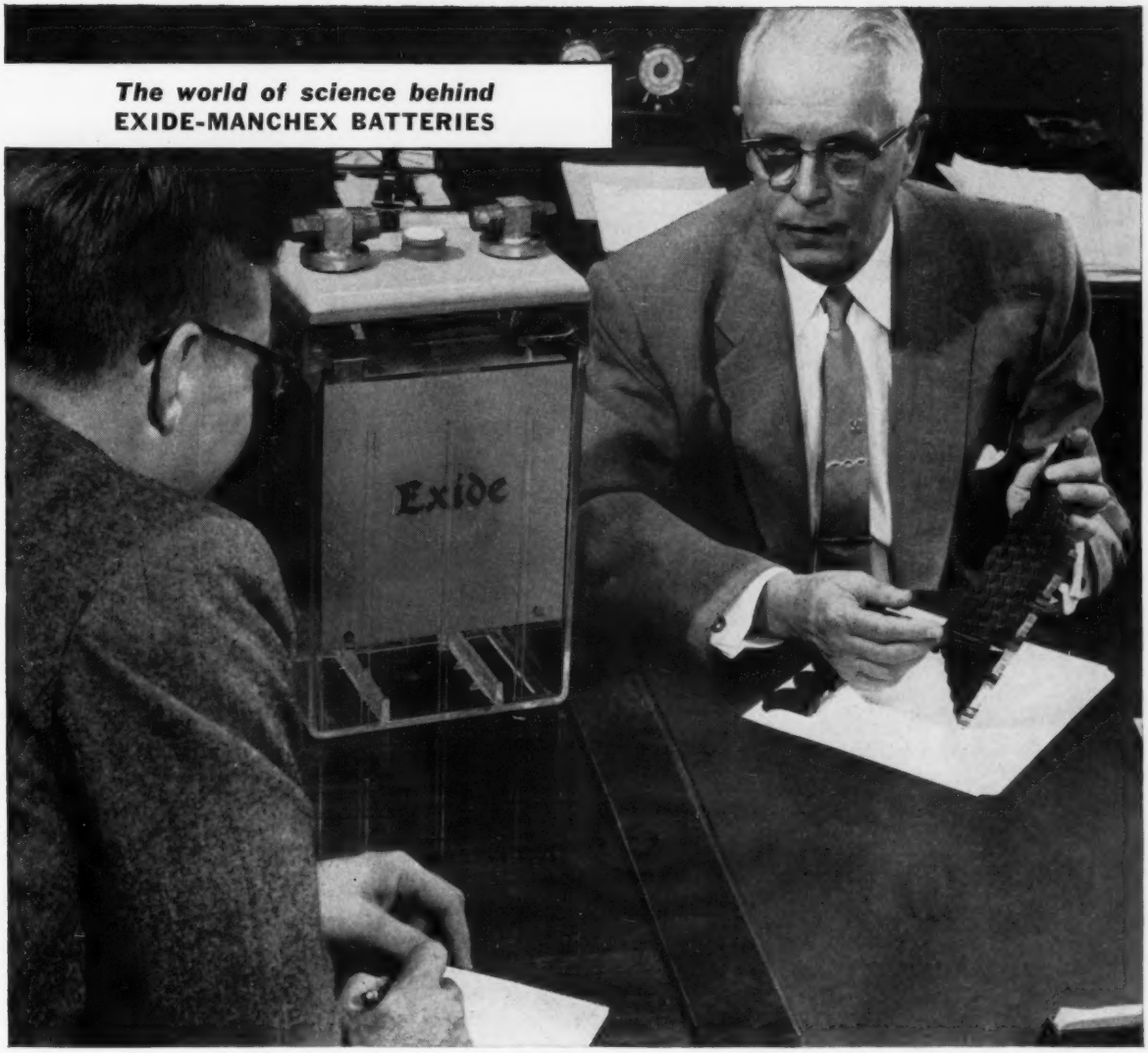
Institute elections

American Welding Society: Clarence P Sander, president; Gustav O Hoglund, 1st vice-president; Charles I MacGuffie, 2nd vice-president. **Steel Founders' Society of America:** Howard F Park Jr, president; B P Hammond, vice-president.

Air Pollution Control Association: Harry M Pier, executive secretary. **Industrial Research Institute:** Thomas H Vaughn, president; Frederick W Stavely, president-elect and member of the board.

"I forgot to blow down on Monday, Tuesday, Wednesday and Thursday so I blew down five times today."

The world of science behind
EXIDE-MANCHEX BATTERIES



Being interviewed is L. E. Wells, Director of Engineering

"The reserve lead stretches battery life"

At the Exide Laboratories—**Reporter:** You're pointing to the lead buttons in an Exide-Manchex positive plate, aren't you?

Wells: That's right. And only a very small portion of the lead is activated when the battery is made. The rest is left in reserve.

Reporter: Why do you provide this reserve lead?

Wells: To keep the battery young. As long as this reserve is there, an Exide-Manchex Battery works just as well as when it comes from the factory.

Reporter: Is that why the battery lasts so long?

Wells: Yes, and there are Exide-Manchex Batteries in use today over 20 years old with years of life left.

Reporter: Don't other batteries have a reserve lead supply?

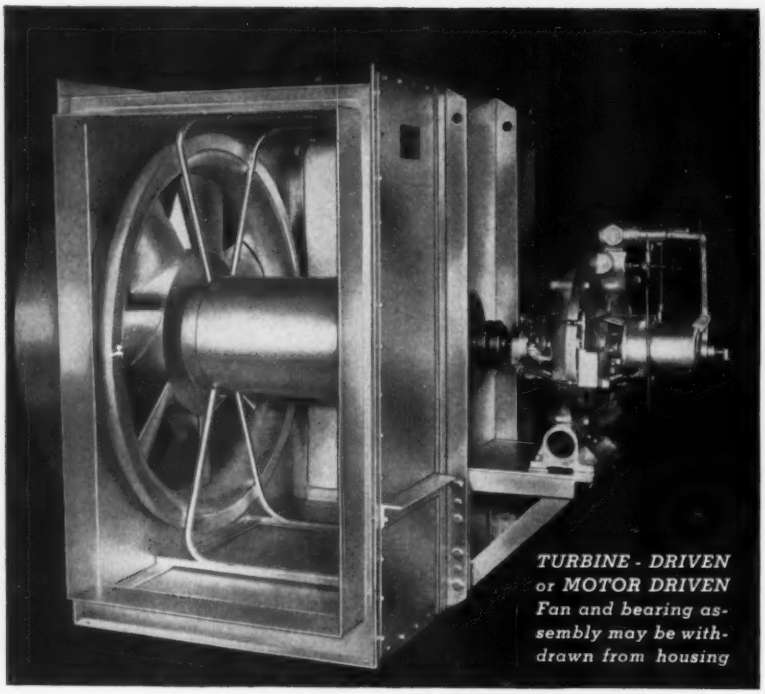
Wells: Yes, but the reserve lead must support a plate. When it gets too thin, sometimes the plate disintegrates. The Exide-Manchex buttons are supported by a special grid that doesn't disintegrate. The reserve lead can be completely used without weakening the plate structure.

Reporter: Obviously this is an important feature in the Exide-Manchex Battery.

Wells: Yes it is, but just one of many engineering details that contribute to their long life.

Note to battery users: When you order batteries for float or cycle service in stationary applications, be sure to specify Exide-Manchex. Write for detailed bulletin. Exide Industrial Division, The Electric Storage Battery Co., Philadelphia 2, Pa.

THE ELECTRIC STORAGE BATTERY COMPANY **Exide**®



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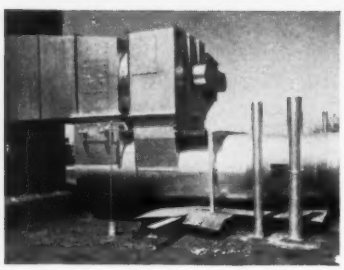

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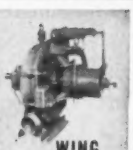
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BOOKSHELF

Pump Selection and Application. *By Tyler G Hicks, Special Projects Editor,* POWER. *422 pp, 6 x 9, cloth, $8.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

The biggest problem facing many engineers today is how to pick and apply the best pump for a given set of conditions. Here is a well-written authoritative guide for all engineers concerned with pumps. It covers the entire field of industrial pumping from tiny units handling a trickle of liquid to the giants handling hundreds of thousands of gallons per minute.

The first three chapters are devoted to the various types and classes of pumps available today. With the pumps classified, the author then discusses the major factors in pump selection—head, capacity, liquid handled, suction and discharge piping, drives, pump purchasing, and economics. The next 14 chapters take up specific pumping problems in more than a score of industries—power, nuclear energy, petroleum, chemicals, water supply, etc. Solutions given relate facts on classes, types, and selection, to present day practice and future pumping trends. These sections tell exactly what kind of pump is being used successfully for a given job. Generalities are avoided and exact data is given.

Every engineer in the power field dealing with industrial pumps will find this book a useful tool in going from raw data to a successful pumping installation. It will help save time, reduce lost motion and secure more for your pumping dollar.

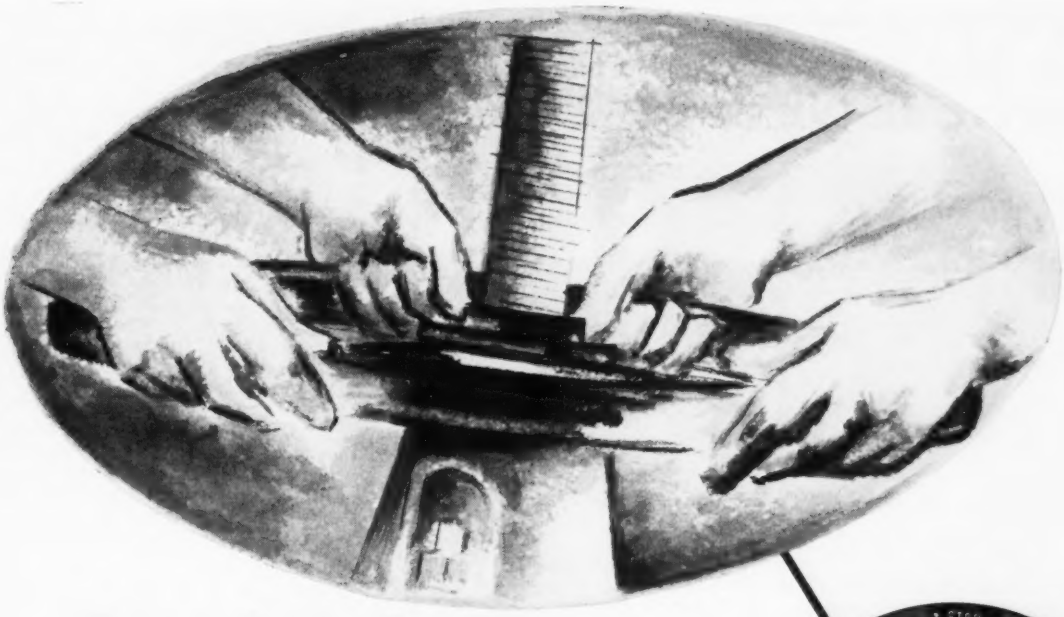
Fundamentals of Vibration Analysis. *By N O Myklestad, head of stress, vibration and gear group, AiResearch Mfg Co of Arizona. 6¼ x 9¼, 260 pp, tables, illust. $6.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

First half of the book deals with systems of one degree of freedom. Written for use in class instruction, it has a large number of examples and problems to illustrate the application of the theories and techniques. Transient vibrations are treated in considerable detail.

Second half of the book covers systems with more than one degree of freedom. The author uses only the classical method of analysis to emphasize the physical fundamentals. He avoids the use of routine numerical methods to help the reader develop a fundamental understanding. Answers to most of the problems are supplied in the back of the book.

Dynamics of Machinery. *By A R Holowenko, Associate Professor of mechanical engineering, Purdue University. 6¼ x 9¼, 464 pp, illust, tables. $7.50. John Wiley & Sons, Inc, 440 4th Ave, New York 16, N. Y.*

Increasing use of high-speed machinery requires more attention to the dynamic effects produced. Designers must become increasingly aware of the balancing of ma-



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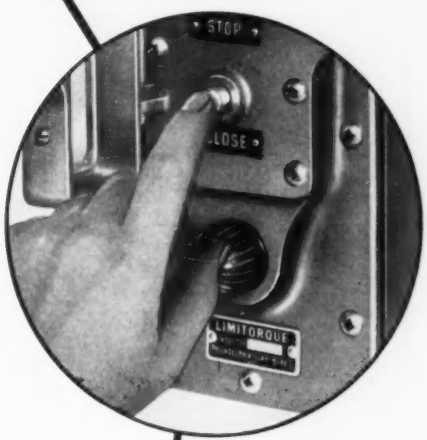

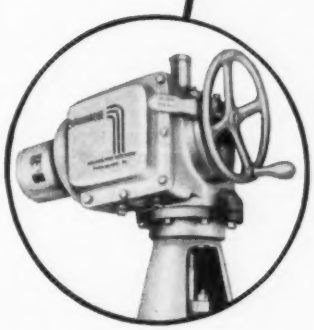

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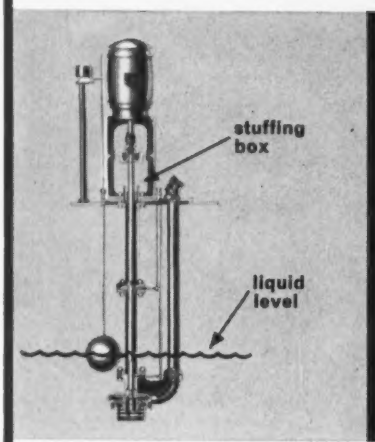

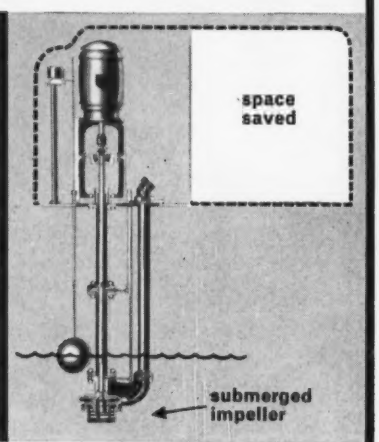

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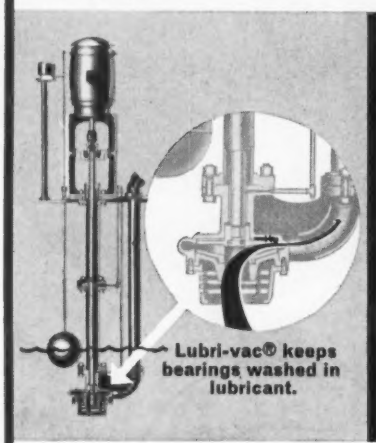
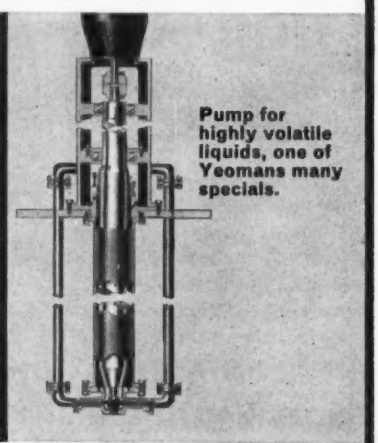
SAVE FLOOR SPACE. They use less than half the space required by horizontal pumps. Also, no priming equipment is needed as with suction lift horizontals. Impellers are submerged in the liquid ready for service.





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More BOOKSHELF

Begins on page 268

chinery and effects of critical speeds. This book has been prepared for use in senior courses on machine design.

Major areas covered include kinematics and force analysis. No attempt has been made to discuss material selection and proportioning of parts for a machine. The book gives all steps in a process of calculation and analysis. Free body diagrams have been applied to all aspects of machine designing as an effective tool for analysis.

The author stresses principles rather than specific problems. This should enable the student to handle more types of problems than given in the book. More than one approach to a problem is explored to give the student greater facility of analysis. Advanced mathematics in the form of differential and integral calculus are used freely in applying techniques.

Dynamics of Machinery. *By James B Hartman, professor of mechanical engineering, Lehigh University. 6½ x 9¼, 283 pp, illust, tables, $7.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

This book intended for advanced engineering students presupposes that the reader has a grounding in statics, dynamics, mechanisms and calculus. Mathematical techniques, not usually given in undergraduate courses on dynamics, are developed as needed throughout the book.

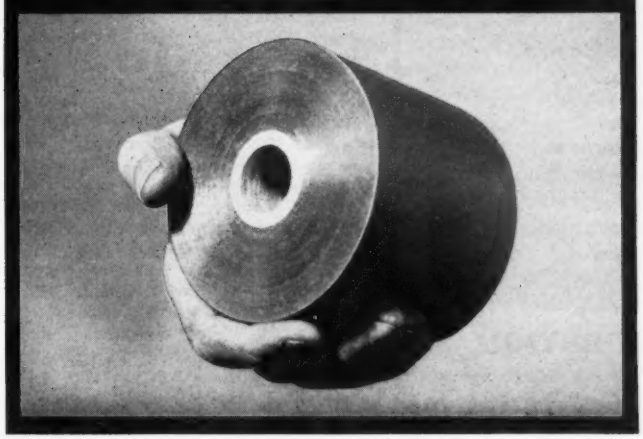
Features of the text include: re-examination of dynamics from an advanced viewpoint; extension of two-dimensional consideration of kinematics and dynamics to the three-dimensional case by vector notation; shows current practical applications of mathematics and dynamics; introduction of mathematical techniques now widely used for automatic controls and servomechanisms.

The appendix gives several special projects intended to develop a professional approach to engineering problems. They vary in length and difficulty, and are suitable for graduate-level work.

Mechanics for Engineers—Statics. *By F P Beer, professor of mechanics, and E R Johnston, Jr, associate professor of civil engineering, Lehigh University. 6¼ x 9¼, 350 pp, illust, tables. $4.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

The approach developed by the authors clearly separates the mechanics of particles from the mechanics of rigid bodies. This makes it possible to consider simple practical applications early in the book and postpone introducing more difficult ideas till later.

New ideas are given in simple terms and every step of the analysis explained in detail. Broader aspects of each problem are explored in regard to extensions and limitations in order to develop a maturity of approach by the student. Concepts of instability and statical indeterminacy, introduced early in the text, are used throughout. (*Continued on p* 272)



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More BOOKSHELF

Begins on page 268

The authors show that mechanics is essentially a deductive science based on a few fundamental principles. Early introduction of free-body diagrams allows stressing them throughout the book. Besides solving equilibrium problems, these diagrams also express the equivalence of two systems of forces or vectors.

The authors work largely uses algebra, trigonometry and elementary calculus. Special notes refresh students on the proper use of the slide rule.

Applied Thermodynamics. Third Edition. *By E B Norris, dean emeritus, Virginia Polytechnic Institute, E. Therkelsen, late professor of mechanical engineering, Montana State College and C E Trent, professor of mechanical engineering, Virginia Polytechnic Institute. 6¼ x 9¼, 490 pp, illust, tables. $7.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

As in previous editions (formerly called "Heat Power"), the authors approach the teaching of thermodynamics from the practical end. After first introducing the mechanical principles upon wrich a machine operates, the book then develops the underlying thermodynamic principles.

The book has htree major divisions: (1) a thermodynamic study of the internal-combustion engine, including spark-ignition, compression - ignition, reciprocating engines and gas turbines (2) a study of steam power generating plants, dust collectors, auxiliaries and steam engines (3) compressors and refrigerating equipment.

On the basis of number of pages, the book pays most attention to major equipment in a steam power plant. This book should appeal strongly to the practical man as compared to the more theoretical.

Power Plans. Second Edition. *By A H Zerban, senior project engineer, Hamilton Standard Division, United Aircraft Corp, and E P Nye, associate professor of mechanical engineering, Pennsylvania State University. 6¼ x 9¼, 655 pp, illust, tables. $8.50. International Textbook Co, Scranton 9, Pa.*

This is a revision of the book originally titled *Steam Power Plants.* This second edition has been broadened by including chapters on hydraulic power plants and internal combustion engine plants.

The discussion deals with the mechanical engineering fundamentals of all types of prime movers for central station generation. It fills the needs of a college course in applied thermodynamics.

Chapter headings give an idea of the book's coverage: steam power plant cycle, fuels, combustion, steady-state heat transfer, furnace heat transfer, steam generators, steam prime movers, fluid handling, instruments and controls, are of heating surfaces, hydraulic power plants, i-c power plants, power plant economics. The last chapter on problems and possibilities includes brief discussions on super-pressure cycles, nuclear plants, and solar energy.

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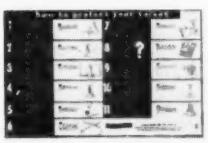

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For heat-saving protection that's permanent...

K&M "Featherweight" 85% Magnesia

When maximum heat-insulating efficiency and economy are called for, not just for a few years but for the life of the equipment, engineers choose K&M "Featherweight"® 85% Magnesia. The deaerating heater and piping illustrated here, for example, are insulated *for life* by "Featherweight."

"Featherweight" 85% Magnesia is the type of heat insulation best suited to the important up-to-600°F temperature range. And in combination with K&M Hy-Temp, it serves with equal efficiency up to 1900°F.

The experienced insulation contractor in your area who can offer you K&M insulations is also well equipped to advise you on heat conservation and dollar savings. Call him or write us for complete information.

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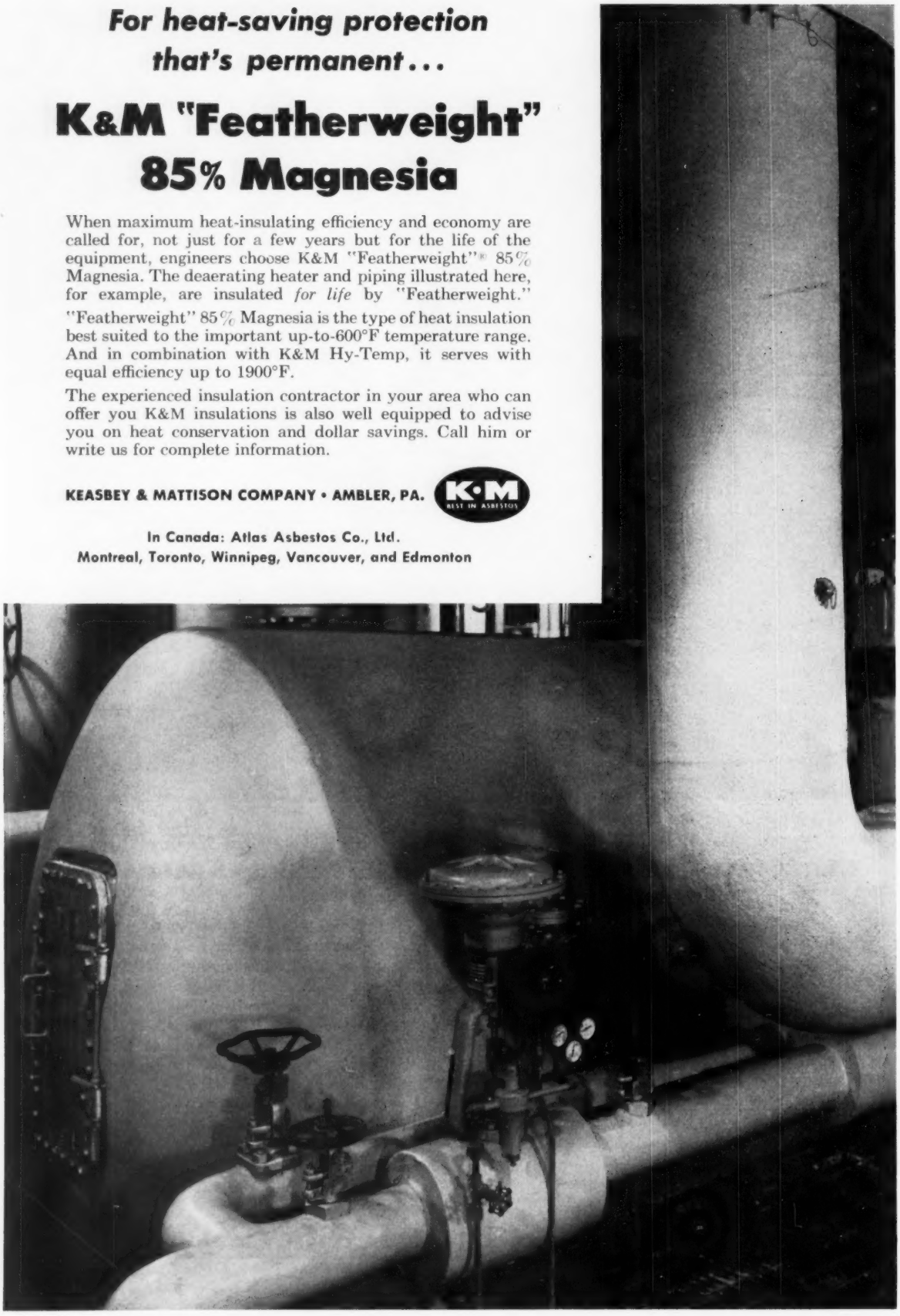

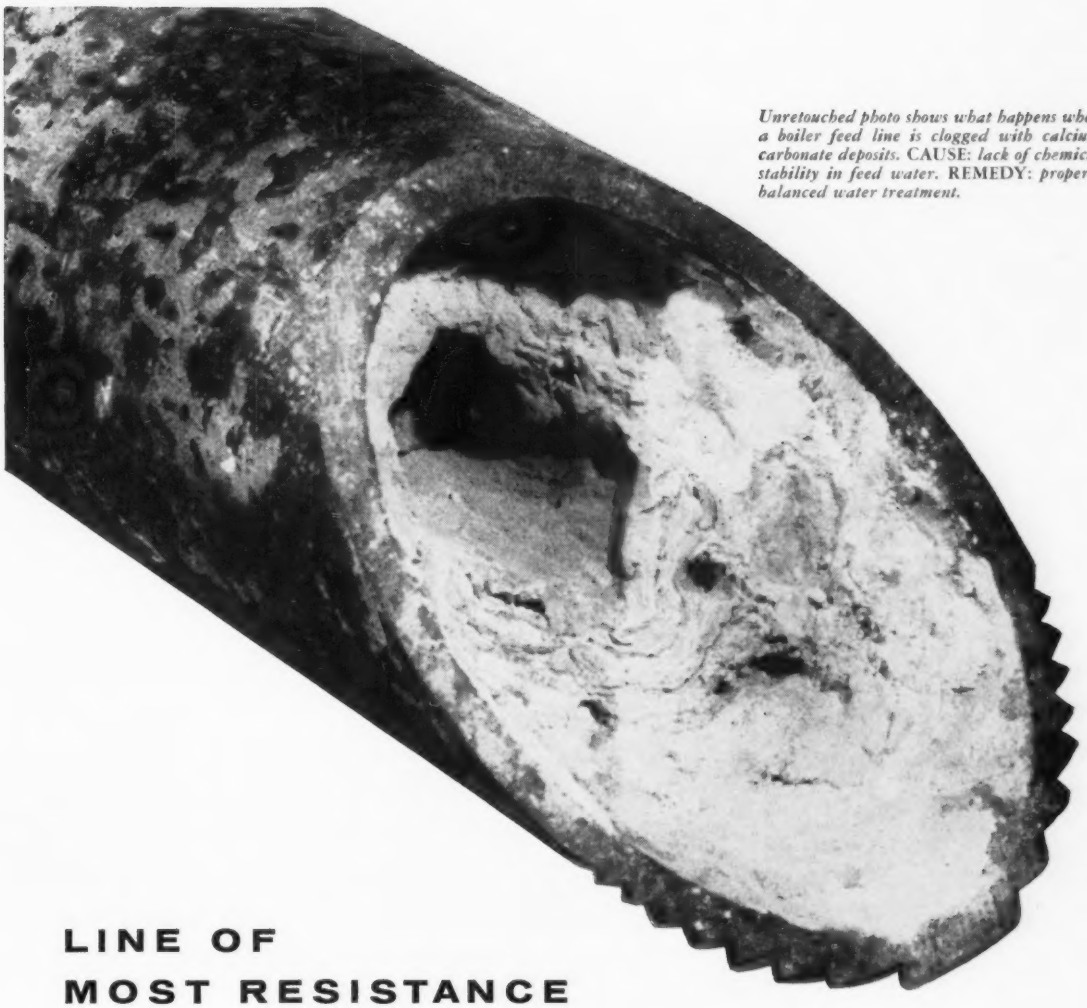

Unretouched photo shows what happens when a boiler feed line is clogged with calcium carbonate deposits. CAUSE: *lack of chemical stability in feed water.* REMEDY: *properly balanced water treatment.*

LINE OF MOST RESISTANCE

A heavy build-up of scale, like that shown in the illustration, will gradually reduce the effective diameter of feed line piping, and will result in seriously restricted carrying capacity.

The line must be shut down for maintenance or replacement, causing expensive down time in the plant. Proper water conditioning will prevent this unnecessary loss. This is but one of the many problems presented by the corrosive elements of water.

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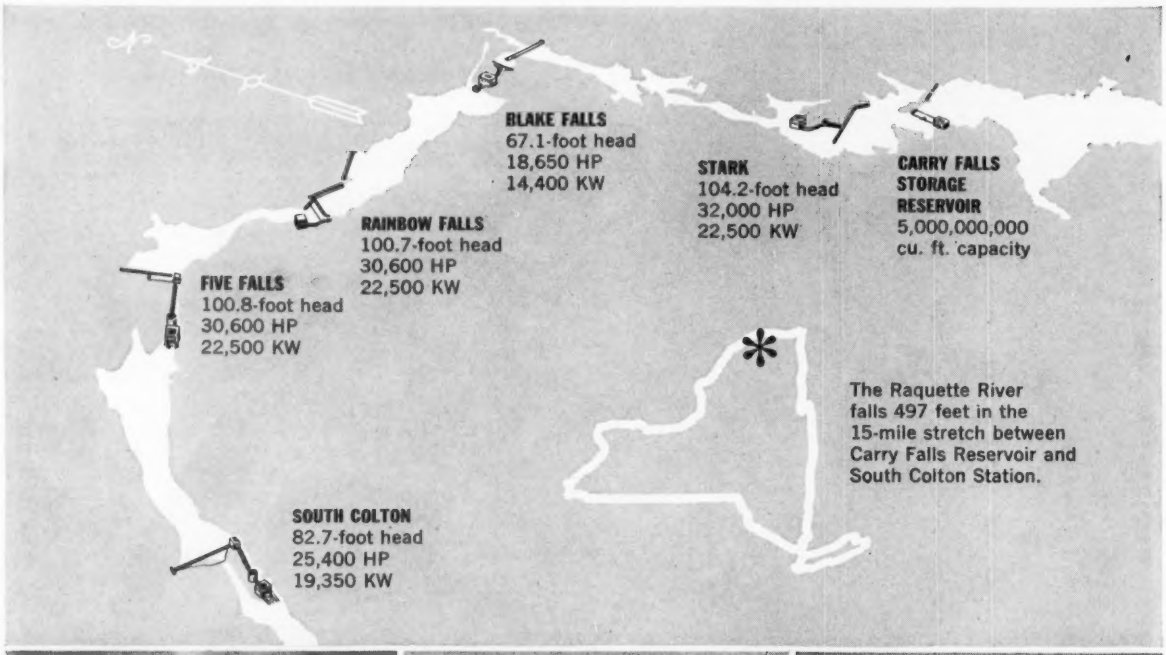

South Colton powerhouse is typical of all 5 unattended stations. Supervisory control of automatic operation will be from Colton, 7 miles downstream.

Two SMS sliding gates with 50,000-lb. twin-drum cable hoists at Carry Falls Dam are designed for free discharge under a 58-foot head. This site can be converted to a hydro plant later if desired.

SMS self-dumping trash rakes operate directly on rack bars, ride down over obstructions and work them loose with a freedom of movement that assures fast, easy cleaning.

5 New Stations On Raquette River Equipped with SMS TURBINES AND ACCESSORIES

To further harness the Raquette River in northern New York, the Niagara Mohawk Power Corp. is now completing a series of five new power plants and a large storage reservoir. Each of these automatic, peak-load stations is equipped with an SMS-Francis turbine. SMS intake gates and twin-drum cable hoists, as well as trash rakes, are also used.

Working in close conjunction with Niagara Mohawk's engineers, SMS used two runner designs in the same basic wheel case for all five units. One runner design was used for the lower head turbines at South Colton and Blake, while another was used for the higher head turbines at Five Falls, Rainbow and Stark. This meant initial economy, and will provide operating and maintenance savings.

Each of the three lower stations uses self-dumping trash rakes at the turbine inlets. This design makes operation quicker and easier, cleans a greater area faster. For full information on these new trash rakes, or on other SMS accessories and hydraulic turbines, write S. Morgan Smith Co., York, Penna.

More Power To . . .

LIVE BETTER ELECTRICALLY

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HYDRODYNAMICS

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

When piping changes direction, protect process equipment with

ZALLEA SELF EQUALIZING UNIVERSAL EXPANSION JOINTS

Zallea Self Equalizing Universal Expansion Joints absorb any movement in any direction . . . axially, laterally, angularly, or any combination of these . . . making them ideal for protecting process vessels and rotating equipment from thermal expansion of connected piping.

When there is a leg or 90° offset to a long run of pipe, one Zallea Universal Expansion Joint will frequently take care of the entire system.

Under conditions of low load requirement for anchors or equipment . . . or when compressive loading in pipe walls must be kept to a minimum . . . Zallea Universal Expansion Joints are the most economical answer to the problem. They absorb the internal pressure thrust. The piping system need only carry the relatively small deflection loads.

Many types of Zallea Tied Expansion Joints are designed especially to absorb lateral deflection or rotation when there is pressure in the line. Universal, Modified Universal, Hinged, Gimbal, Pressure Balanced and Universal Pressure Balanced Expansion Joints give you a choice of the type best suited to your particular application.

Get the complete story of Zallea Expansion Joints in our new 72-page manual. Write, on your company letterhead, for your copy of Catalog 56. Zallea Brothers, 814 Locust Street, Wilmington 99, Delaware.

Zallea
expansion joints

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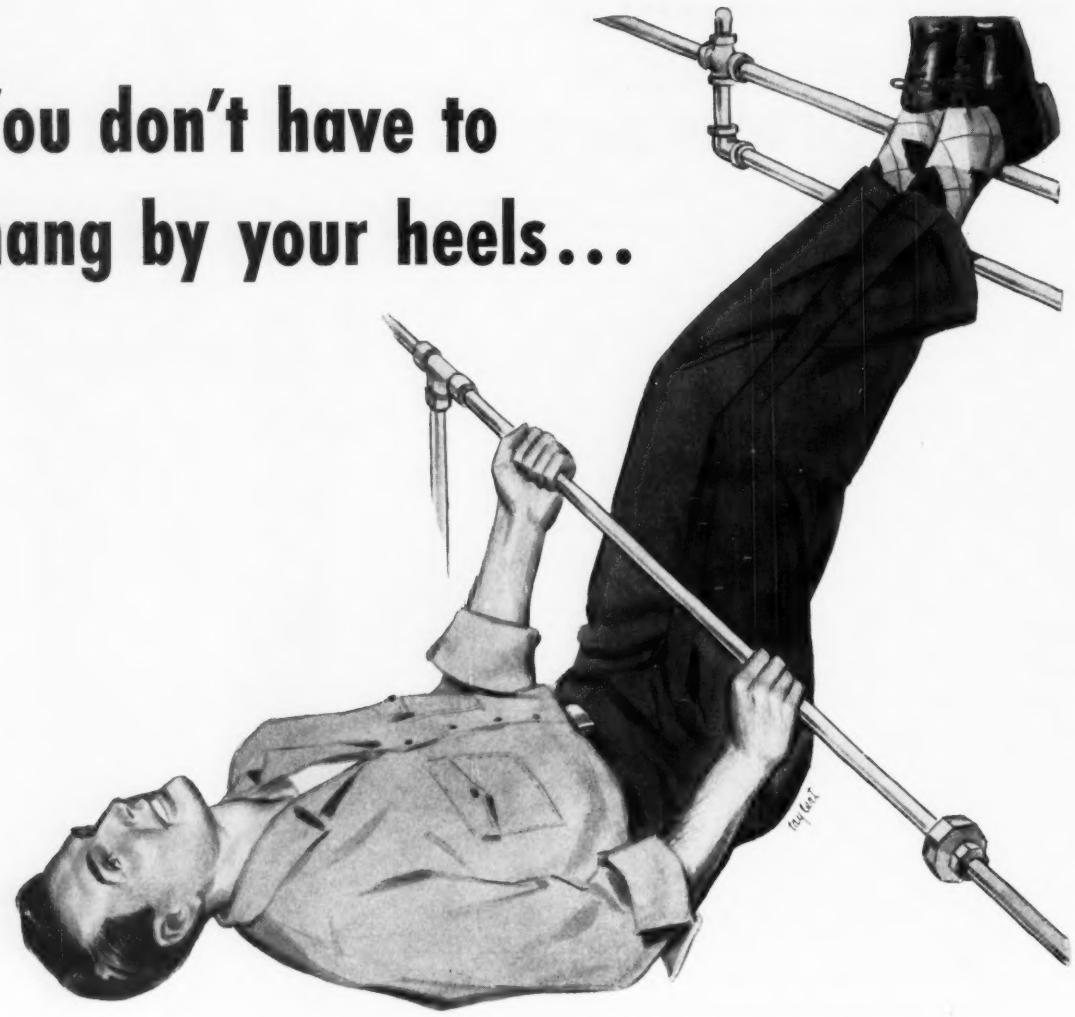
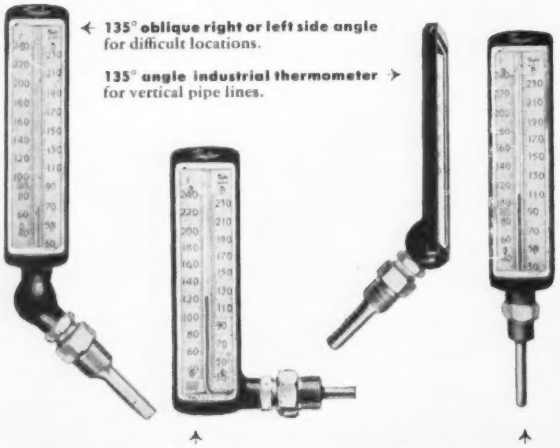
World's largest manufacturer of expansion joints

24" dia. Zallea Universal Self Equalizing Expansion Joints in service lines of the engine test facility of a West Coast aircraft manufacturer.

You don't have to hang by your heels...



to read a Taylor Industrial Thermometer



← **135° oblique right or left side angle** for difficult locations.

135° angle industrial thermometer → for vertical pipe lines.

90° right or left side angle for side installations. Can be tipped forward or backward for eye level reading.

Straight industrial thermometer for inserting in horizontal pipe lines.

EASY-READING Taylor Industrial Thermometers come in a wide variety of stem angles and connections to fit the most difficult applications.

Easy temperature readings mean *more frequent* temperature readings—greater protection for your expensive equipment and more efficient plant operation.

Exclusive BINOC* tubing and extra-bold black numerals make Taylor Industrial Thermometers *three-times-easier-to-read.* Ranges from minus 40° to plus 950°F. or equivalent Centigrade. Built for years of rugged, reliable service. Write for **Catalog E.** Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada.

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Taylor Instruments
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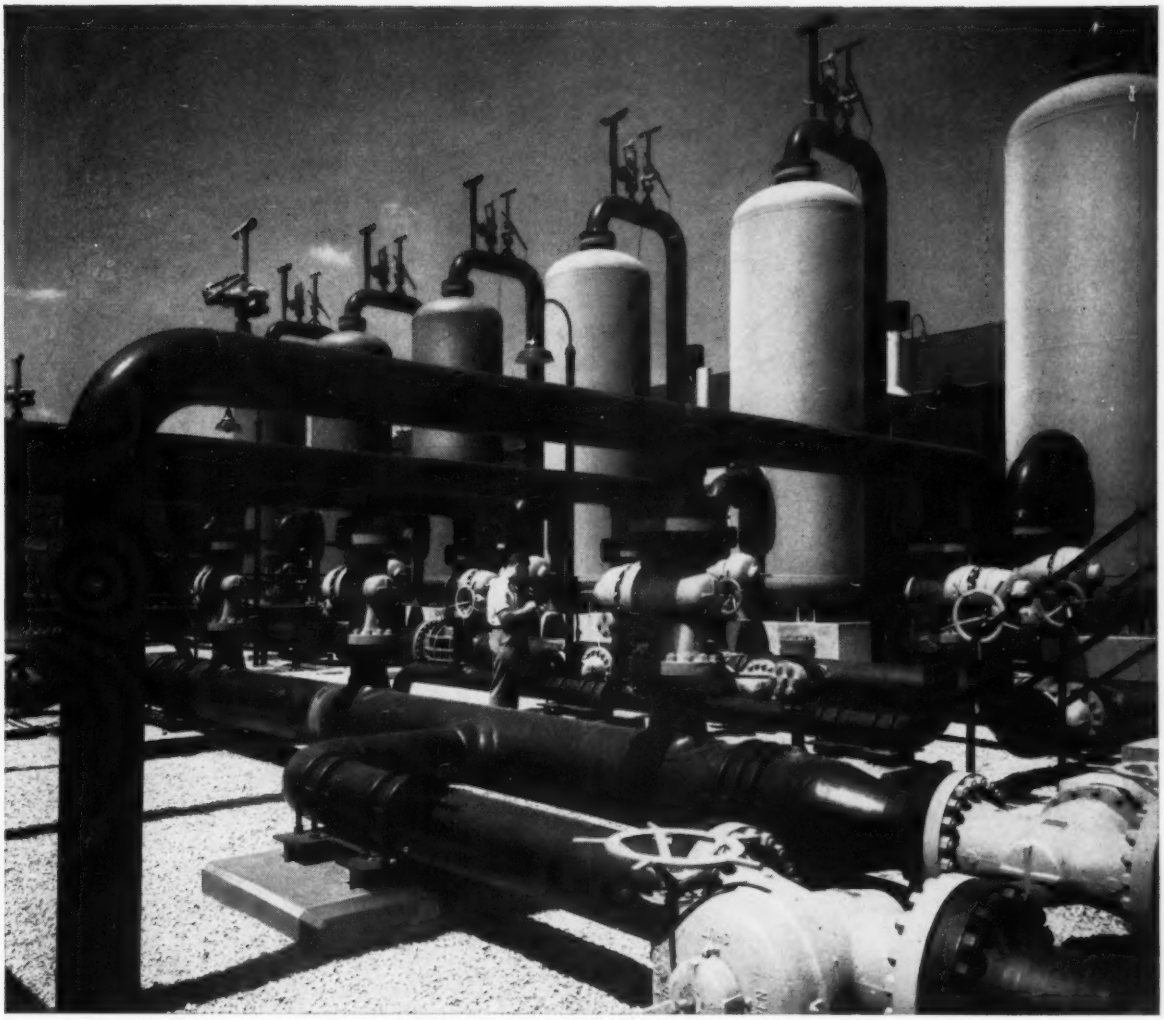

Original station and expansion...

BOTH BY DRAVO

United Fuel Gas Company's compressor station at Lanham, West Virginia, was built by Dravo to route gas from the southwest for storage or for use in the eastern and northern markets.

Increased demands called for an addition to double the original capacity of the station. Three compressors, jacket water cooler, gas cooler and three gas scrubbers, together with the necessary building extension, were installed. The contract also included the fabrication and erection of all piping for the fuel gas, oil and water lines as well as for the gas lines.

Space limitations required compact design. The erection of new equipment and piping had to be accomplished without interrupting normal operation. Despite these handicaps, the addition was completed on schedule.

You, too, can profit from Dravo's single-contract responsibility for the fabrication and erection of piping and complete facilities. For information, write DRAVO CORPORATION, PITTSBURGH 25, PA.

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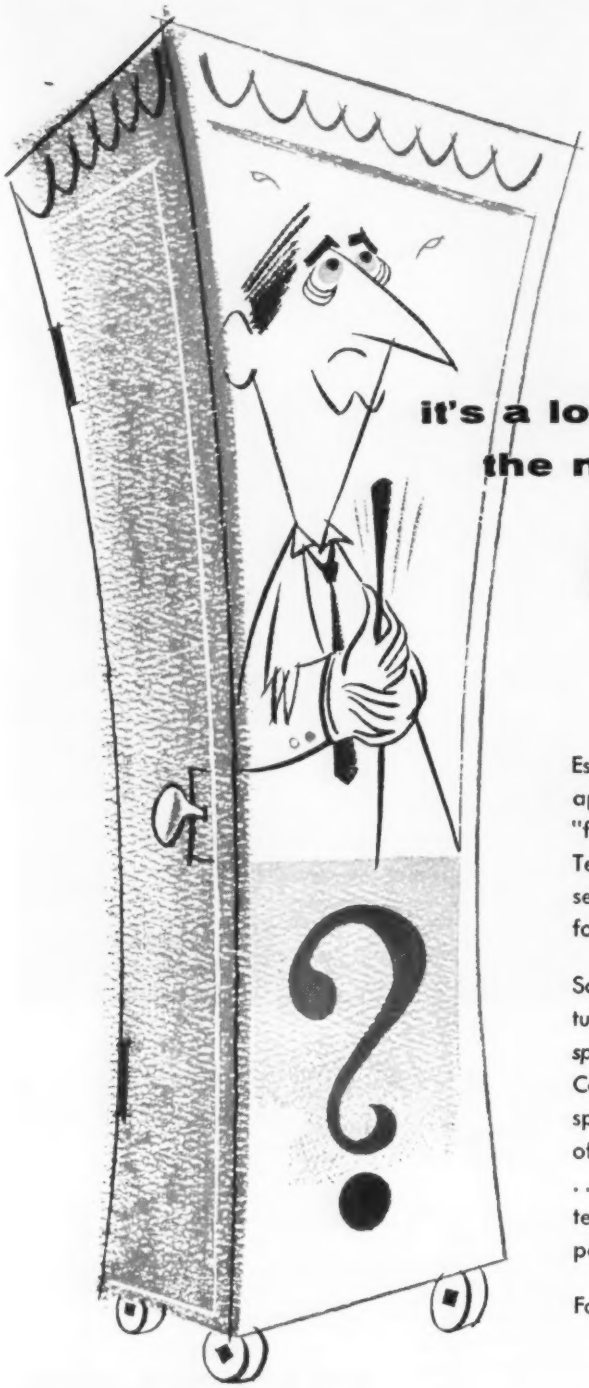
Blast furnace blowers • boiler and power plants • bridge sub-structures • cab conditioners • docks and unloaders • dredging • fabricated piping foundations • gantry and floating cranes • gas and oil pumping stations • locks and dams • ore and coal bridges • process equipment • pumphouses and intakes • river sand and gravel • sintering plants • slopes, shafts, tunnels • space heaters • steel grating • towboats, barges, river transportation



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heat exchanger tube questions

Especially in steam power, petroleum and petrochemical applications, Scovill Heat Exchanger Tube has been "first choice" for many years. As a result, Scovill Technical Service has an experience background second to none. This experience is at your service for the asking.

Scovill regularly produces all the popular copper-base tube alloys. We add a number of important *extra specifications* of our own . . . the unique advantages of Continuous Casting (Phosphorized Admiralty) . . . specially developed Scovill techniques in hot extrusion of "tube shells" and cold-drawing of the finished tube . . . Scovill quality control and detailed inspection and test procedures . . . even extra care in shipment to assure perfect tube condition at the time of installation.

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HEAT EXCHANGER TUBE FOR APPLICATIONS FROM MARINE TO PETROCHEMICAL . . . FROM COMPRESSOR INTERCOOLERS TO "CAT-CRACKER" EXCHANGERS . . . IN THESE POPULAR ALLOYS
Phosphorized Admiralty • Admiralty • Arsenical Admiralty • Naval Brass • Red Brass, 85% • Deoxidized Copper
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SBC 57

EXPANSION JOINTS

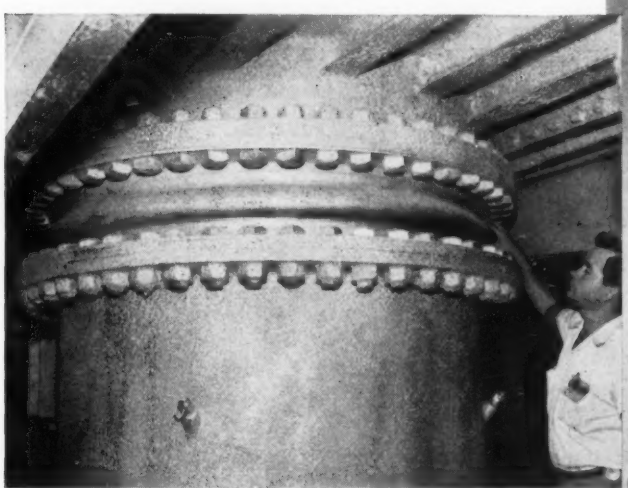
84,000 Gallons of Water per Minute for atomic energy plants

The Clifty Creek steam electric plant brings in and expels river water at 84,000 gallons per minute, by means of circulating water pumps. To help quench this huge thirst, U. S. Rubber Expansion Joints (from small 8-inch type to big 66-inch type) are used on the water intake and discharge pipes.

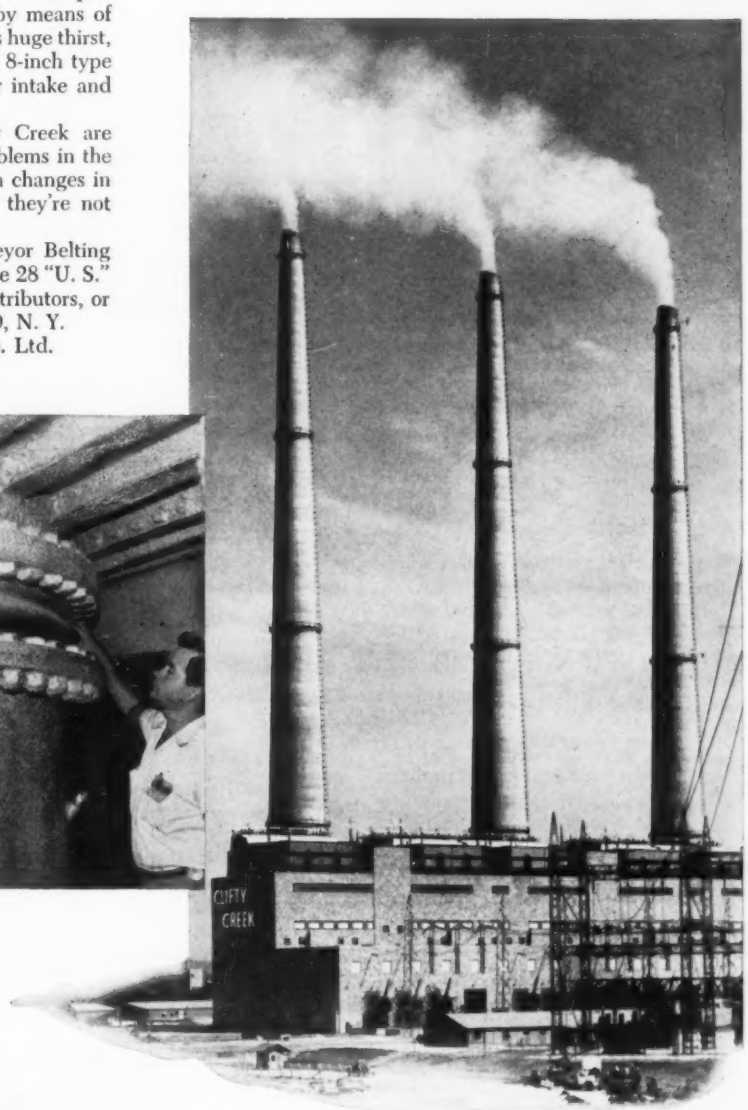
These U. S. Expansion Joints at Clifty Creek are handling the contraction and expansion problems in the pipe lines excellently. They can take sudden changes in temperature, they can handle shocks, and they're not bothered by corrosion.

A complete line of U. S. Rubber Conveyor Belting and Expansion Joints is available at any of the 28 "U. S." District Sales Offices, at selected "U. S." distributors, or write us at Rockefeller Center, New York 20, N. Y.

In Canada, contact Dominion Rubber Co. Ltd.

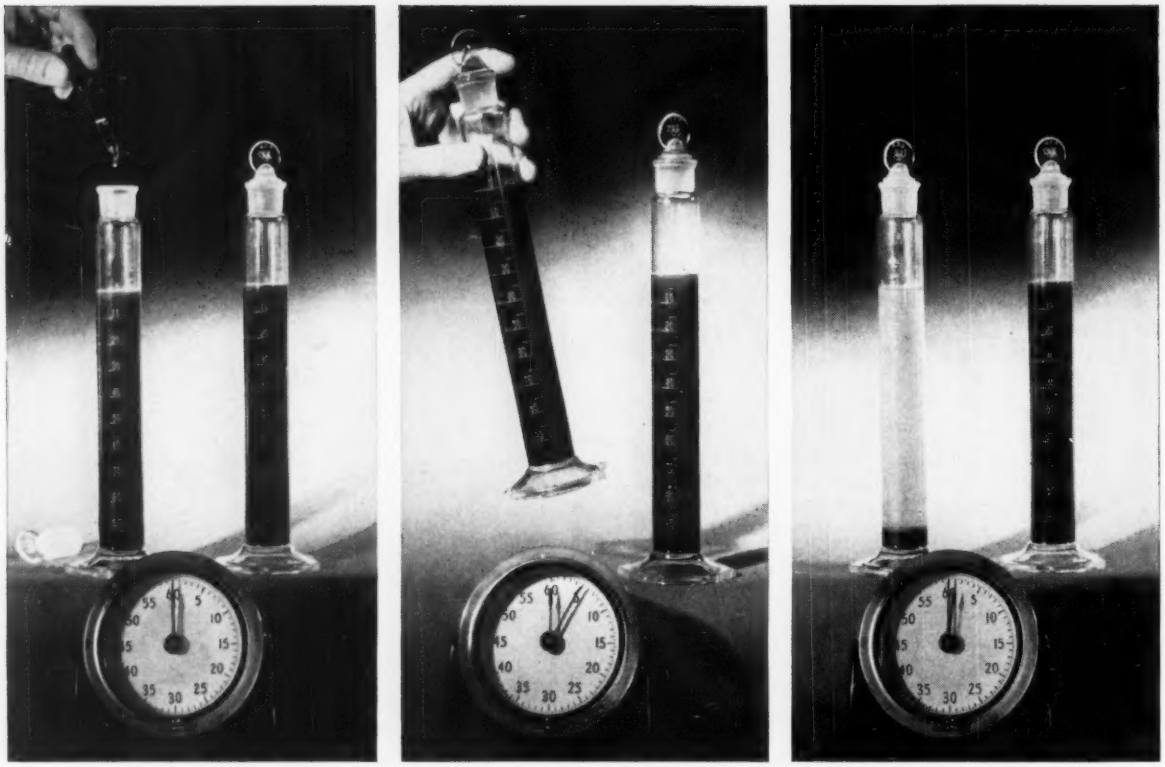


Above is one of the many 66-inch U. S. Expansion Joints on a water intake line at the Clifty Creek Plant. None of these joints, no matter what the size, has ever given Clifty Creek any problem. They are performing excellently, on a tough job.



Mechanical Goods Division

United States Rubber



Demonstration: Add Separan 2610 . . . mix . . . in a few seconds, solids settle . . . compare with untreated solids.

New flocculating agent Separan 2610 clears process and waste water in record time

New flocculant proves to be faster and more economical answer to many old problems in process water and waste treatment operations. Separan 2610® speeds up settling and filtration rates . . . brings many other improvements to liquid-solid separations!

PROVEN APPLICATIONS

Process water treatment – improves throughput and performance in hot and cold lime softeners, chemical flocculation units!

Sewage–speeds dewatering of digested elutriated sewage sludge!

Oily waste disposal – improves floc blanket flotation on refinery water effluent flotation unit!

Foundry waste–reduces stream pollution and provides cleaner recycle water!

Pulp & paper waste–increases solids recovery, lowers sewer loss!

Coal washing–improves fines recovery, increases throughput of settling unit!

Electroplating–settles solids in combined cyanide, chrome and acid wastes; speeds filtering!

Chemical wastes–improves solids recovery; less material loss!

EXAMPLES OF RESULTS

Separan 2610 was applied at 0.25 ppm to a cold lime softener supplying cooling tower make-up water. The sludge blanket became stabilized, effluent turbidity was reduced from an average 10 ppm to less than 5 ppm, and the unit operates more efficiently. Flocculant savings with Separan 2610 exceed $110 per month on a throughput that averages 900 gpm.

Another plant uses Separan 2610 in dewatering of digested elutriated sewage sludge on vacuum filters. This application has brought a 24% increase in filter capacity and a 20% reduction in total chemical flocculant cost.

In oil refineries, similar improvements are being experienced in flotation units for clarification of combined oily wastes. By adding 0.5 ppm Separan 2610, along with alum, to waste water in a flotation unit, plants have improved floc blanket stability and reduced the oil content of the effluent.

MANY APPLICATIONS HAVE BEEN TESTED

Separan 2610 has shown excellent results in many waste and process water applications. It is an organic flocculating aid that is easy to prepare and apply, noncorrosive, and that presents no hazard in normal handling and industrial use. Samples and technical assistance are available by writing us. For further data, request one of our new booklets on Separan 2610 in "Waste and Sewage", "Water Treatment", "Coal Industry", or "Pulp and Paper". THE DOW CHEMICAL COMPANY, Midland, Michigan, Dept. SC1321J-1.

YOU CAN DEPEND ON DOW

"Air flow" design prevents cavitation in Butterfly Valve

Throttling water at a high rate of flow may cause critically high velocities through the restricted area and develop a vapor pocket immediately down stream of the valve. The alternate buildup and collapse of this vapor pocket develops supernormal pressures on the face of the valve disc, accelerating erosion and causing shocks in the piping system. This phenomenon, known as cavitation, may occur regardless of the shape of the valve disc or its material of construction.

This unusual problem arose in planning the Pleasant Valley Hydro-electric Plant. Although ultimately intended for open-shut service, the 96" penstock intake valve would have to throttle flow through the waterway during the plant construction period. Pratt engineers knew from experience that cavitation would probably occur and sought to forestall damage to the valve disc and pipeline structure.

The problem was solved with a design which allows atmospheric air to pass down the valve shaft and out through holes in the valve disc, preventing the formation of low pressure areas.

The valve and reducer are under 65 feet of water and the electric motor operator is on a floor 68 feet above the valve centerline. An oil-filled standpipe balances pressure in the reducer with outside water pressure.

This imaginative engineering is the result of 30 years experience in butterfly valve design. Specifying Pratt valves puts this experience to work for you. It helps keep installation costs down and assures years of efficient, economical operation.

96" valve for penstock intake at Pleasant Valley Hydro-Electric Power Plant, Los Angeles, Cal. ENGINEERS: Los Angeles Department of Water and Power.

NEW! Latest, most accurate pressure drop and flow data, conversion tables, discussion of butterfly valve theory and application plus other technical information.

Write for Manual B-2K.

HENRY PRATT

RUBBER SEAT Butterfly Valves

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities

"BUFFALO" BUILDS A "CUSTOM" PUMP FOR EVERY JOB IN YOUR PLANT

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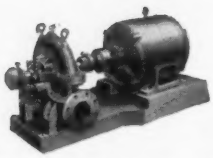
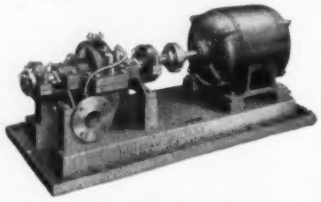
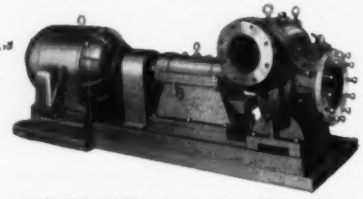


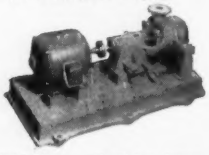
CLEAR WATER—For clear water service there is no more efficient pump than the double-suction "Buffalo" Type "SL". Its hydraulic balance, its free-flow water passages and husky construction mean economical service over many years. Capacities from 10 to 14,000 gpm. Write for Bulletin 955.



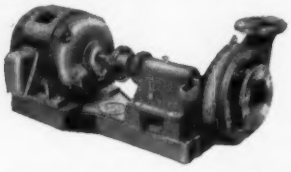
HIGH PRESSURE – "Buffalo" Type "RR" Multi-stage Pumps combine rugged strength and efficiency on boiler feed and other clear water service, against heads as high as 1500 feet, in capacities up to 900 gpm. Shafts are extra-heavy with ball bearing support on both ends — stuffing boxes are deep. Write for Bulletin 980 for all engineering details.



NON-CLOGGING – For moving high-consistency liquids, "Buffalo" Diagonally Split-Shell Pumps offer freedom from expensive shutdowns. And since efficiency does not depend on close impeller clearances, there is no problem of "wedging" and wear. Available rubber-lined for corrosive or abrasive liquids. Write for Bulletin 953.



HEAT TRANSFER – "Buffalo" Heat Transfer Pumps are specifically designed for high-temperature liquids. Successfully used in large installations, they employ special water-cooled bearings and packing, plus suitable alloys — built into our basic, efficient single-suction, solid shell design. Write for engineering details.



CHEMICAL LIQUIDS – "Buffalo" builds 10 special types of chemical pumps in a wide choice of trim for almost any corrosive, abrasive or high-consistency liquid. Above is a single-suction, full ball bearing model. Write for Bulletin 982 and check this wide selection.

Because "Buffalo" builds a *complete* line of pumps tailored to the liquid-moving applications of every industry, you get all the benefits of a custom-designed pump — without paying a "custom" price. You can match a "Buffalo" Pump to your exact conditions — and enjoy the high efficiency, easy maintenance and long life that only such a pump can deliver. Shown here are some of the types — simply write us about your problem, and we'll recommend the *right* pump!

ALSO . . . *"Buffalo" Close-Coupled Pumps, Sump Pumps, and Raw Sewage Pumps — all with the "Q" Factor, or built-in Quality which provides trouble-free satisfaction and long life in every "Buffalo" product.*

"Buffalo" PUMPS

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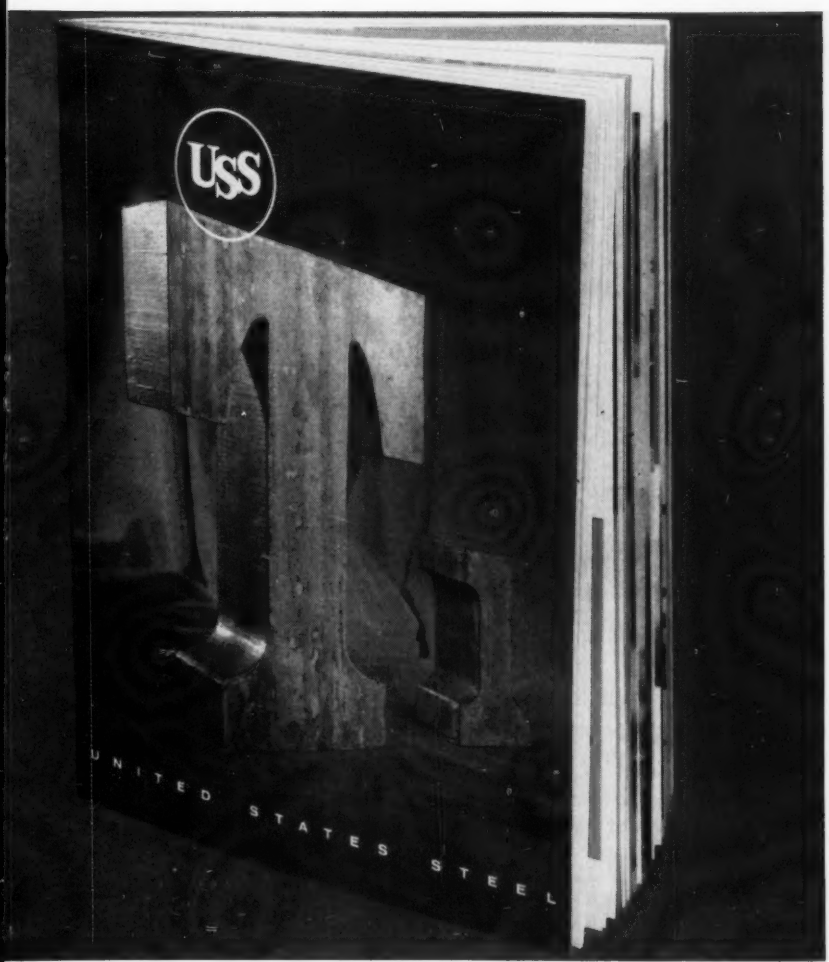

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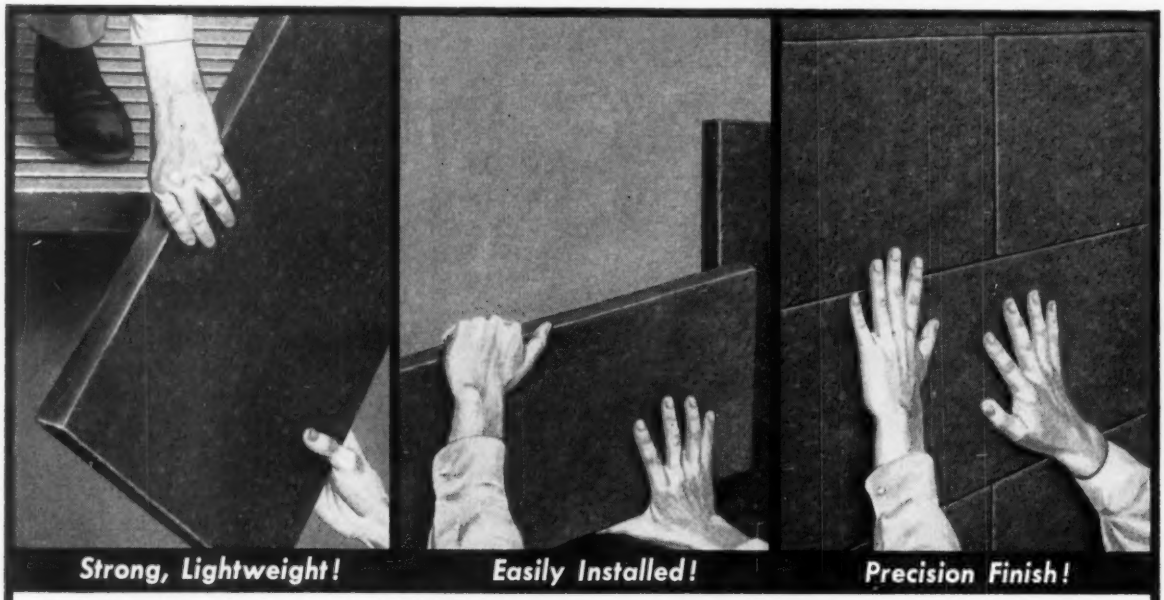

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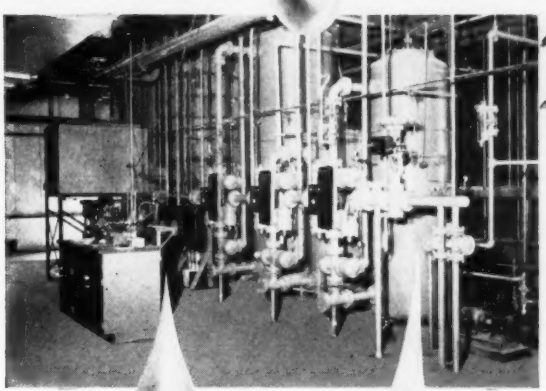

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Raytheon Manufacturing Company ... Quincy, Mass.
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Minnesota & Ontario Paper Company ... Internat'l Falls, Minn.
Great Northern Oil Company ... Roseport, Minn.
International Paper Company ... Natchez, Miss.
General Tire & Rubber Company ... Ashtabula, Ohio
Turnsted Division, General Motors Corp. .... Columbus, Ohio
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It will pay you to investigate. Write today for Bulletin 1960-C. Inquiries are invited on all water and waste treatment problems, including boiler feed water makeup, process water clarification and purification, waste pollution control, material reclamation and related needs.

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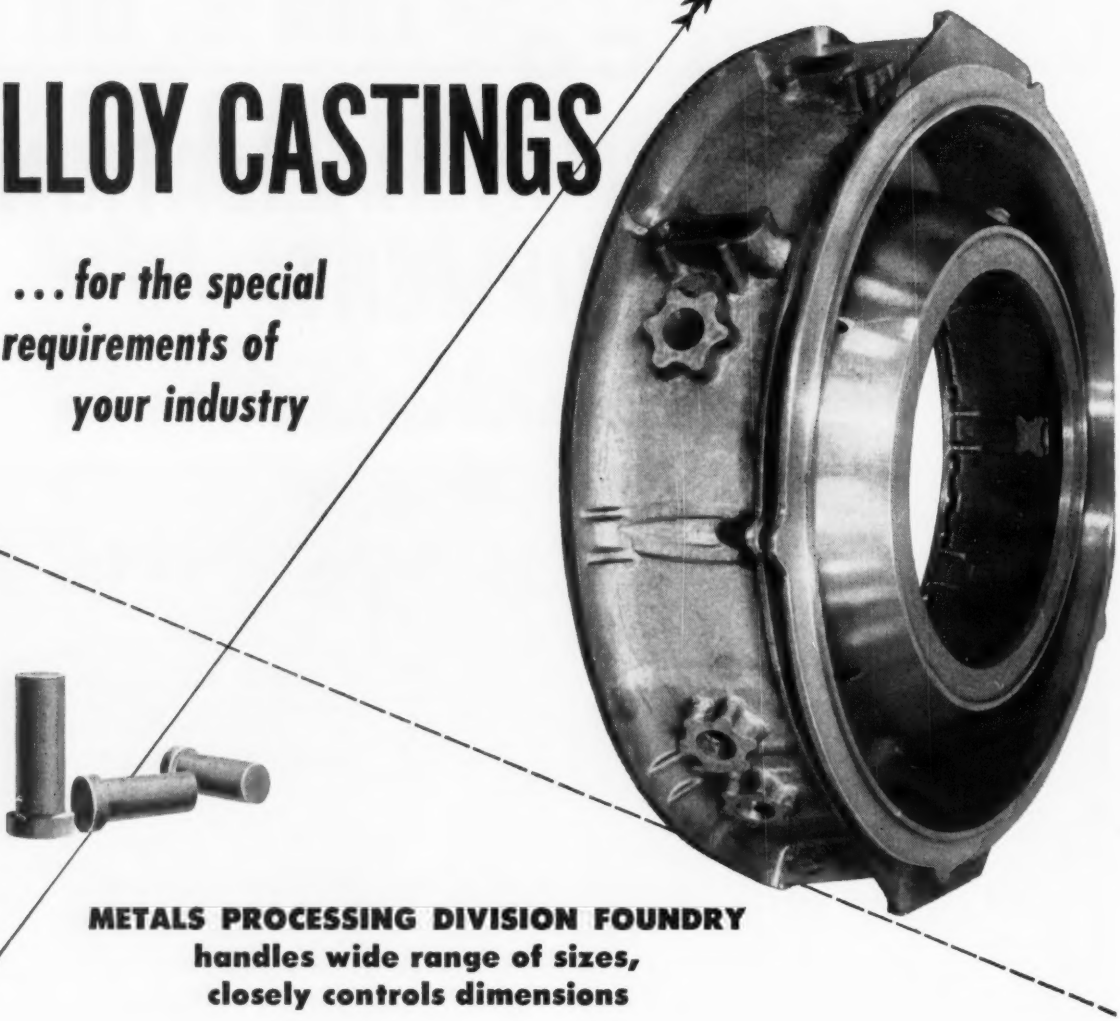

METALS PROCESSING DIVISION FOUNDRY handles wide range of sizes, closely controls dimensions

Precision testing methods provide close control of casting quality

Curtiss-Wright's Metals Processing Division today offers your industry precision castings of critical parts in a wide variety of sizes, and with closely controlled dimensions. For example, in the large casting shown, tolerance is ±.030 over 36″ diameter. From its modern, completely equipped foundry in Buffalo, the Division supplies heat, corrosion and abrasion resistant castings from a full range of special-property alloys, including ductile iron... by sand, centrifugal, ceramic or shell processes.

Precision alloying techniques, modern melting controls with spectrometer testing, X-ray control by experienced radiographers – all add up to castings with superior physical and mechanical properties . . . mean better and more dependable products for the critical needs of industry. Qualified design engineering assistance is a part of the comprehensive Metals Processing Division service. Write for details.

88 GRIDER STREET

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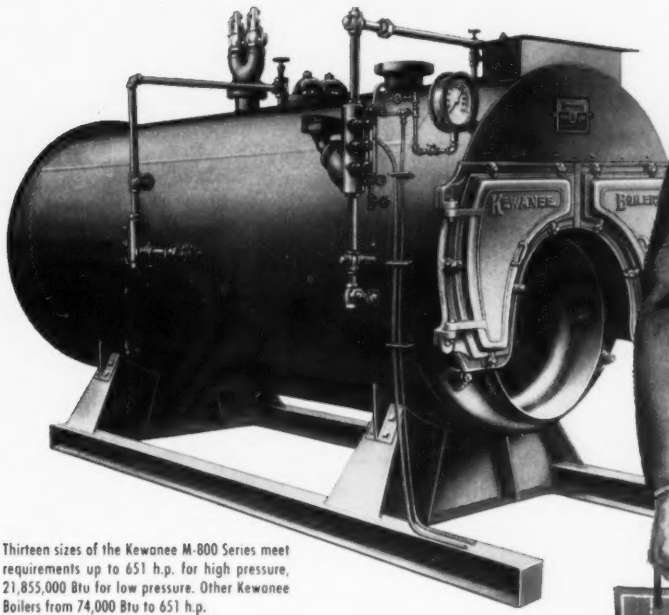
the men behind the **KEWANEE** *boiler . . .*

and the man **before** it!



Thirteen sizes of the Kewanee M-800 Series meet requirements up to 651 h.p. for high pressure, 21,855,000 Btu for low pressure. Other Kewanee Boilers from 74,000 Btu to 651 h.p.

Designer, purchasing agent, machinist, welder—dozens of specialists are behind the Kewanee Boiler. To them goes the credit for "cruising speed" operation . . . dependable performance . . . ease of maintenance . . . long life.

But your Kewanee Man comes *before* the boiler. He's in your office ahead of installation—even specification. He tells you of new Kewanee developments and applications. He keeps your catalog up to date. When you need specific information, he either has it or can get it quickly.

He is nearby, for the network of Kewanee Boiler representation stretches coast-to-coast. Remember to phone whenever he can be of help. AMERICAN-STANDARD, KEWANEE BOILER DIVISION, 101 Franklin Street, Kewanee, Illinois.

Kewanee Boilers are advertised regularly in national publications.

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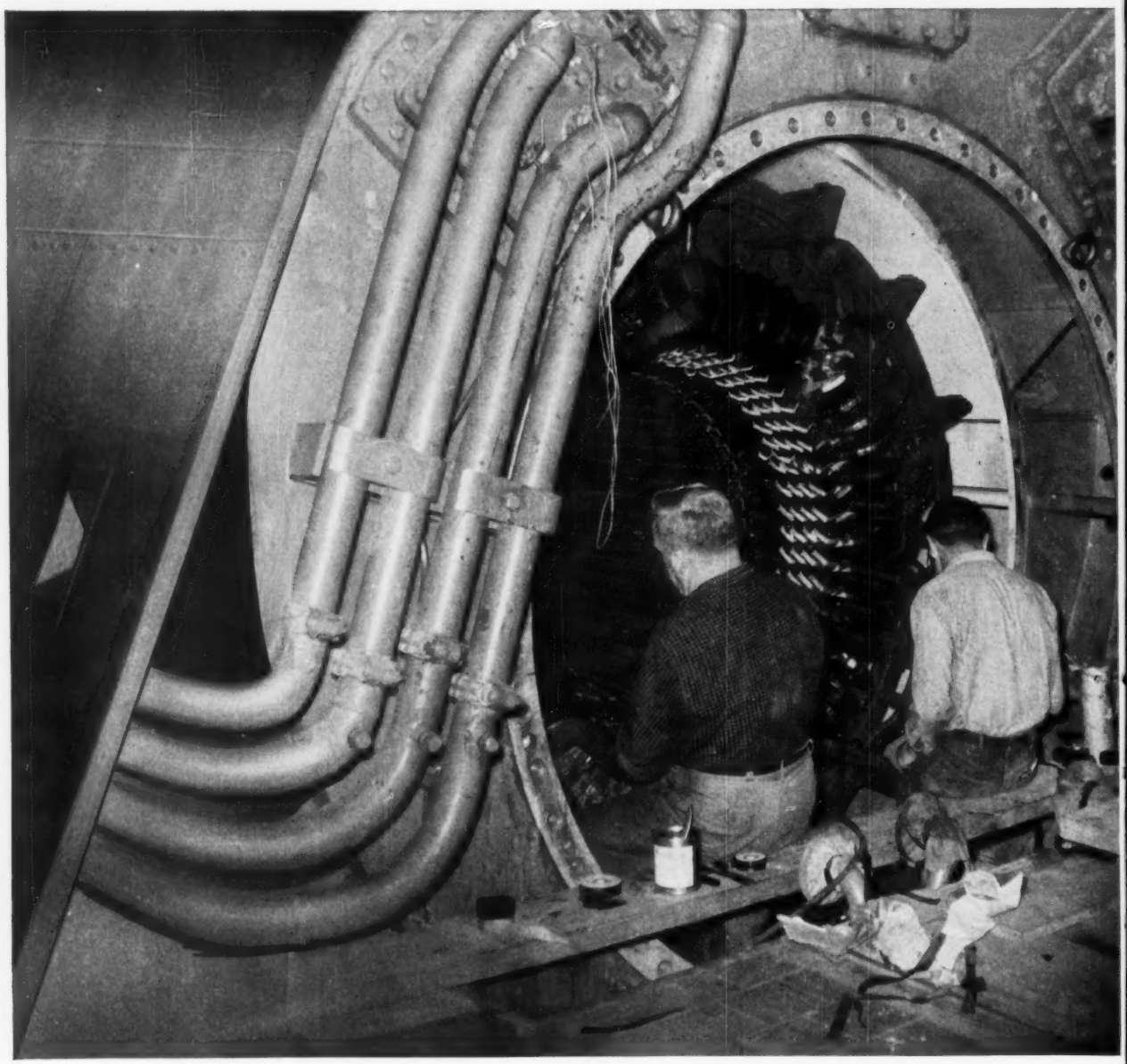
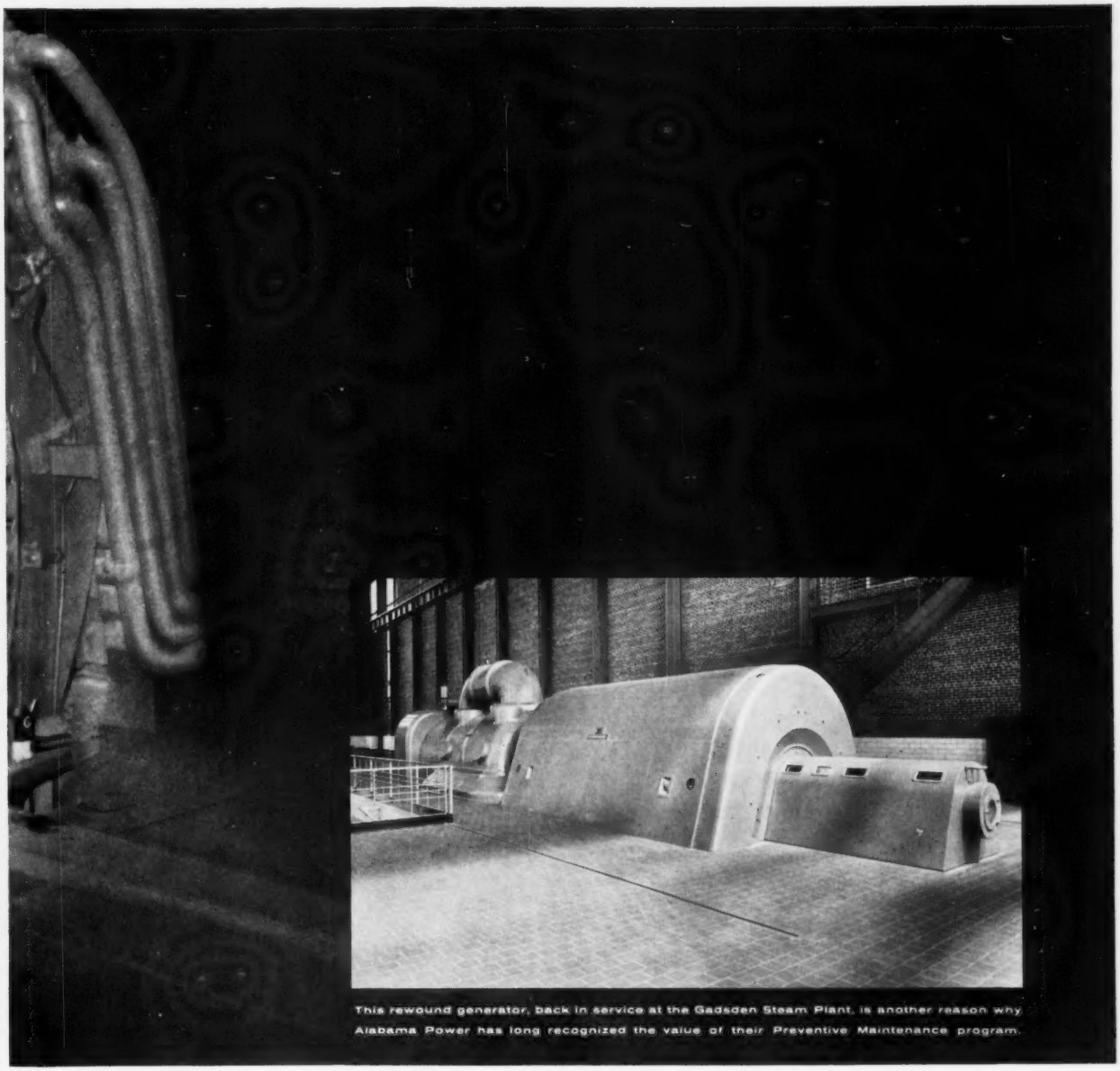


Westinghouse Preventive Maintenance at Alabama Power Company

FROM COIL ORDER TO COMPLETED REWIND IN 4 WEEKS



This rewound generator, back in service at the Gadsden Steam Plant, is another reason why Alabama Power has long recognized the value of their Preventive Maintenance program.

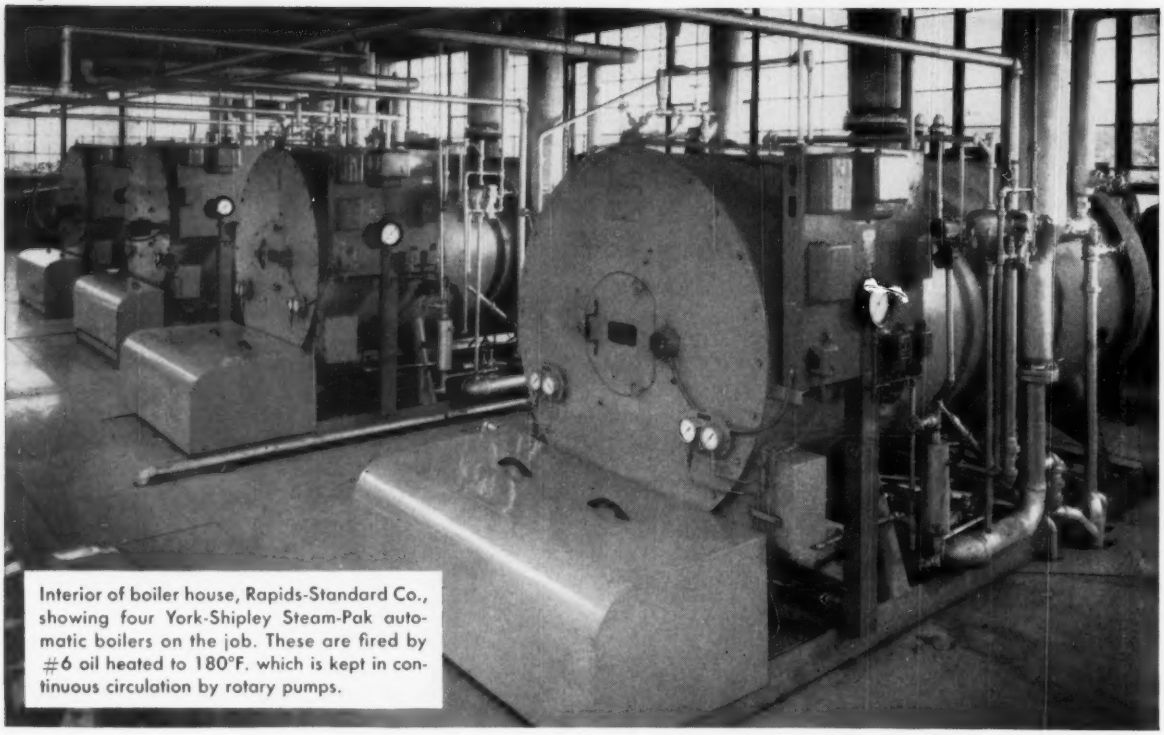
Westinghouse Preventive Maintenance Inspection Service serves Alabama Power Company, again. When Westinghouse field engineers inspected this 60,000-kw generator in February, 1957, during scheduled overhaul of the generating unit, they found conditions which led to a decision to rewind it during the outage then in progress. Westinghouse was ready with men and materials to do the job.

Alabama Power stated the unit couldn't be out of service for more than 5 weeks, or they would suffer additional loss. Westinghouse alerted its personnel, ordered the coils and started working 20 hours a day, 6 days a week, to strip and rewind. The job was completed March 14th, 28 days after the customer order was given.

Skilled, highly trained Westinghouse field personnel will perform preventive maintenance inspection, on-the-spot repairs and modernization to keep your electric apparatus operating at peak efficiency. Nationwide, they are on call 24 hours a day with fast, reliable service.

Contact your Westinghouse salesman, or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa. J-95183

YOU CAN BE SURE...IF IT'S Westinghouse



Interior of boiler house, Rapids-Standard Co., showing four York-Shipley Steam-Pak automatic boilers on the job. These are fired by #6 oil heated to 180°F. which is kept in continuous circulation by rotary pumps.

They're saving money today . . . and looking after tomorrow, too !

How York-Power Steam-Paks more than doubled heating output . . . with no increase in building costs.

For more than eight years, two YORK-POWER Steam-Paks had been supplying ample heat for the Rapids-Standard Company in their Plymouth, Michigan plant.

The efficiency and economy records of these boilers were so high that when the time came to double plant facilities, company engineers realized they could do no better than to add two more Steam-Paks to take care of increased heating needs.

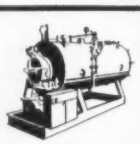
"From our particular view point," said Mr. Russell A. Inwood, Vice President of Engineering and Manufacturing, "the flexibility which YORK-POWER Steam-Paks provided for continuous expansion was of greatest importance. Also, because there were no expensive chimneys or foundations to construct, and because the units were pre-wired and pre-piped, we could cut down on installation costs."

SAVED BUILDING COSTS. Merely by rearranging the floor plan of the over-size boiler house, it was found that two more Steam-Paks could be set up . . . with *no extra building costs.* These four units now take care of all present heating needs and also provide for continued expansion for many years to come.

Find out how YORK-POWER Steam-Paks can help you. Our engineers are available to give full cooperation. Specification sheets and detailed data are yours for the asking. Write TODAY.

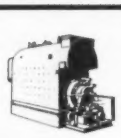
Industrial Division **YORK-SHIPLEY, Inc.** YORK, PENNSYLVANIA

ONLY YORK-POWER OFFERS A COMPLETE LINE OF AUTOMATIC BOILERS, BURNERS, AND FUEL BURNING SYSTEMS

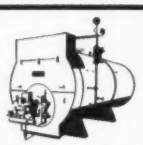


STEAM-PAK
15 to 600 Hp.
Oil and/or Gas Firing

STEAM-PAKETTE
10 to 50 Hp.
Oil and/or Gas Firing



FIRE-PAK
35 to 485 Hp.
Oil and/or Gas Firing



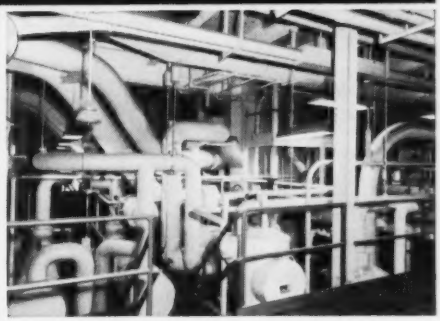
SCOT-PAK
52 to 400 Hp.
Oil and/or Gas Firing

ECONOL BURNER
5 to 28 G. P. H.
Oil Firing

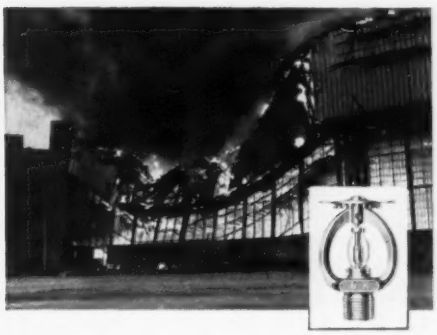
ROTARY BURNER
18 to 400 Hp.
Oil and/or Gas Firing

F/C SYSTEMS
Automatic Fuel
Burning Systems

BLAW-KNOX has what it takes—to provide these products and services



Heater piping system in this modern generating station is typical of many high temperature, high pressure systems prefabricated and erected by Blaw-Knox. Experienced piping engineers, modern shop facilities and a new Blaw-Knox digital computer method for fast, accurate calculation of piping stresses are available to you. Let us know your requirements and we'll provide the service you need. For more information, write for Bulletin No. 2443—"Piping for Industry."



Out of every 100 firms who lose their records in a fire, 43 never reopen for business. Be safe. Let a Blaw-Knox fire-protection engineer study your needs—and explain how you can pay for the system on our lease or deferred payment plan. To get more information send for Bulletin No. 2426—"Fire Can Destroy Your Business."

Blaw-Knox trapeze functional spring hanger installed in first large atomic generating station. Vital power piping system for the atomic generating unit in the Duquesne Light Company's Shippingport Station is supported by Blaw-Knox custom-engineered hangers.

Blaw-Knox makes a complete line of standard and custom-engineered pipe hangers, supports, and vibration eliminators. Each is a complete packaged unit, designed for a specific purpose and constructed to comply with the "code for pressure piping." Available in types and sizes to meet varying conditions, ready to install.

Blaw-Knox engineers, who have solved many difficult hanger and piping vibration problems, are always available to both design and make recommendations for your hanger requirements. For further information, write for Catalog No. 54.

BLAW-KNOX

BLAW-KNOX COMPANY

Power Piping and Sprinkler Division

829 Beaver Avenue • Pittsburgh 33, Pennsylvania

Complete facilities for prefabrication and erection of piping systems for all pressures and temperatures ... complete line of standard and custom-engineered pipe hangers, supports and vibration eliminators ... complete line of automatic sprinkler systems for standard and special hazards

NUCLEAR NEWS FROM ATOMICS INTERNATIONAL

AI develops reactors for largest power plants and smallest research labs

A wide selection of nuclear reactors, ranging in size from a 75-megawatt nuclear power plant to generate electricity, to a 5-watt laboratory instrument, have already been completed, or are at present under construction by ATOMICS INTERNATIONAL.

The Sodium Reactor Experiment, part of the Atomic Energy Commission's program to develop economical nuclear power, now undergoing tests in the Santa Susana Mountains near Los Angeles, will have an output of 20 thermal mw and will generate about 6.5 mw of electric power. It is the prototype of a full-scale sodium graphite reactor design, which will have a power output of 75 to 125 mw. ATOMICS INTERNATIONAL regards it as a promising reactor type for economical power generation.

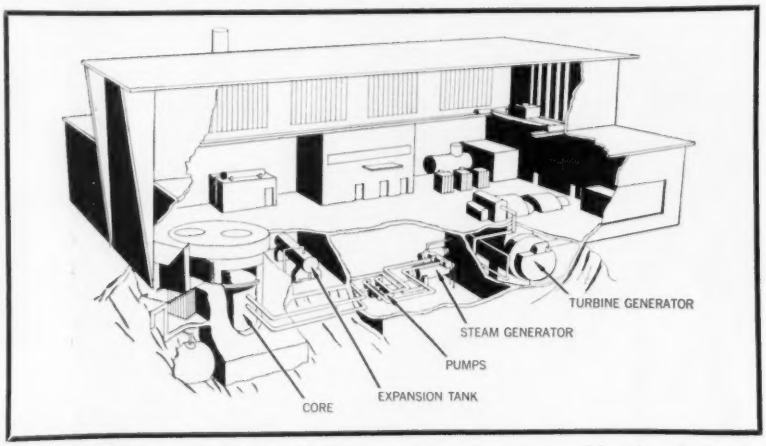
The Organic Moderated Reactor, a relatively new approach to economical nuclear power, is particularly appropriate for smaller plants. ATOMICS INTERNATIONAL is completing construction of the Organic Moderated Reactor Experiment for the Atomic Energy Commission at the National Reactor Testing Station in Idaho, part of a development program for the OMR. Basic advantages of the OMR include compact core with good neutron economy, low pressure coolant system, and freedom from corrosion problems. The OMR is also considered promising for ship propulsion, and ATOMICS INTERNATIONAL is making a design study of this reactor type for maritime use.

Research Reactors are now being built by ATOMICS INTERNATIONAL for Japan, Denmark, West Germany, and West Berlin. They are similar to the ATOMICS INTERNATIONAL reactor now in service at Armour Research Foundation, Chicago—the first to be designed specifically for private industrial research.

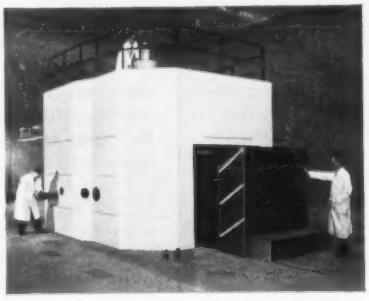
The Laboratory Reactor is a new, low-cost instrument designed specifically to meet the needs of universities and industrial laboratories for nuclear training and research.

ATOMICS INTERNATIONAL, one of America's major builders of nuclear reactors, is staffed and equipped to help you with any phase of reactor development. Please write: Director of Technical Sales, Dept. PW-73, ATOMICS INTERNATIONAL, P. O. Box 309, Canoga Park, Calif. Cable address: ATOMICS.

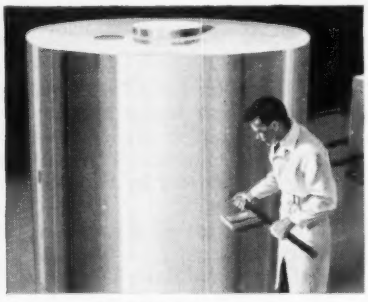
Reactor "heart". An AI technician installs zirconium "cans" containing the graphite moderator in the core of the Sodium Reactor Experiment. The use of a sodium coolant allows a high-temperature, low-pressure heat extraction system with high thermal efficiency of power conversion.



Typical OMR Central Station Power Plant. Basic advantages of OMR include small size, compact core, low-pressure system, and freedom from corrosion problems. This also makes it a promising reactor for ship propulsion.

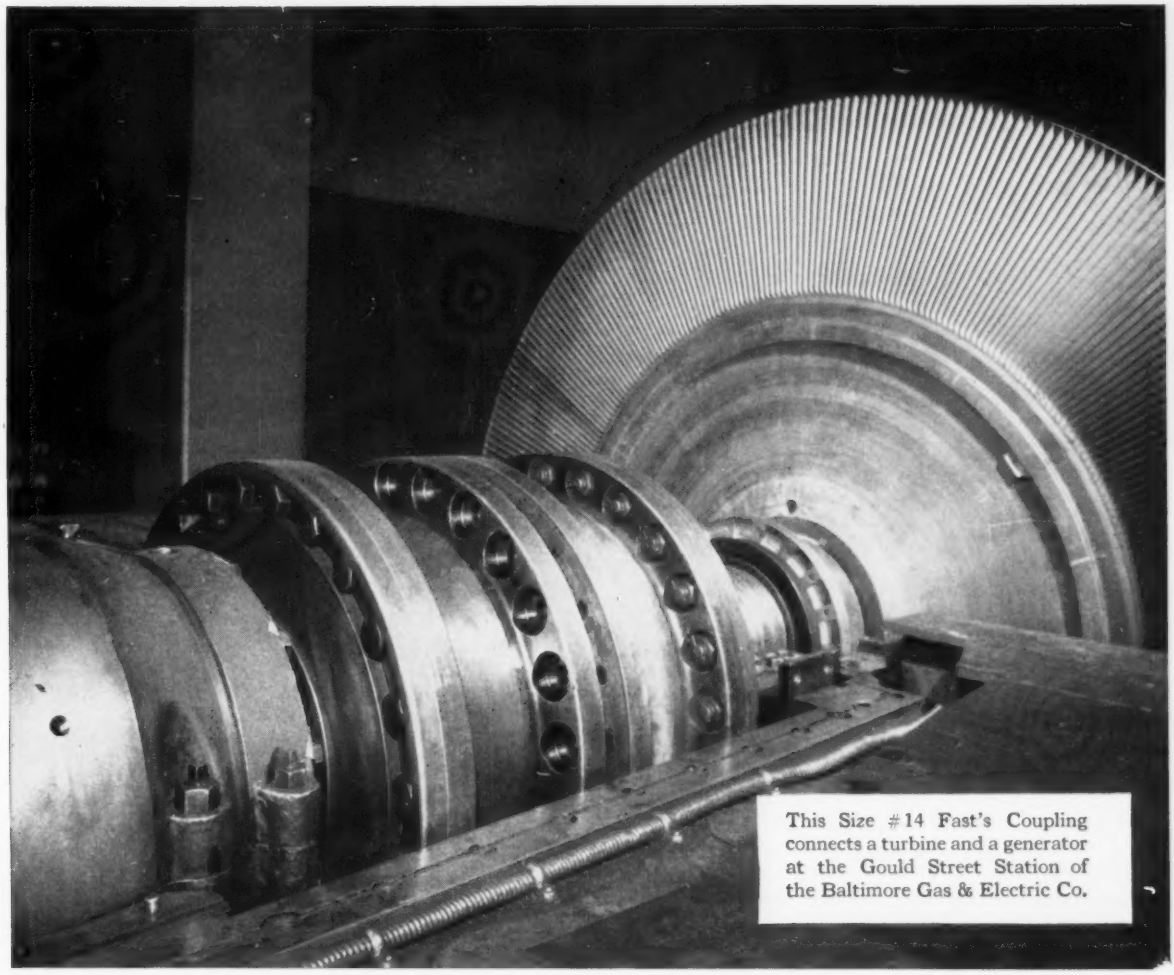


Armour Reactor is a 50 kw water-boiler unit for industrial research. It has nine beam tubes for experimental purposes.



Nuclear Nutshell. Laboratory Reactor operates at 5 watts of power and produces more than 100 isotopes. It can be operated by one trained man.

ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.
PIONEERS IN THE CREATIVE USE OF THE ATOM



This Size #14 Fast's Coupling connects a turbine and a generator at the Gould Street Station of the Baltimore Gas & Electric Co.

This Fast's Coupling runs smooth after 29 years of service!

This Size #14 Fast's Coupling has never had a major part replaced since its installation on January 4, 1927.

The Baltimore Gas & Electric Company has provided excellent care and inspection . . . examining the coupling during each routine overhaul of the turbine and generator. The last inspection (shown above) was during the fall of 1955.

Unique design permits Fast's Couplings to compensate for both offset and angular misalignment of shafts and eliminates the wear of metal upon metal. It provides positive lubrication which forms a film on load-carrying surfaces of the teeth. Metal bearing rings located at the mid-axis of the teeth keep out dirt, grit and moisture—keep lubricant in. Fast's metal-to-metal seal protects the lubricant against pollution.

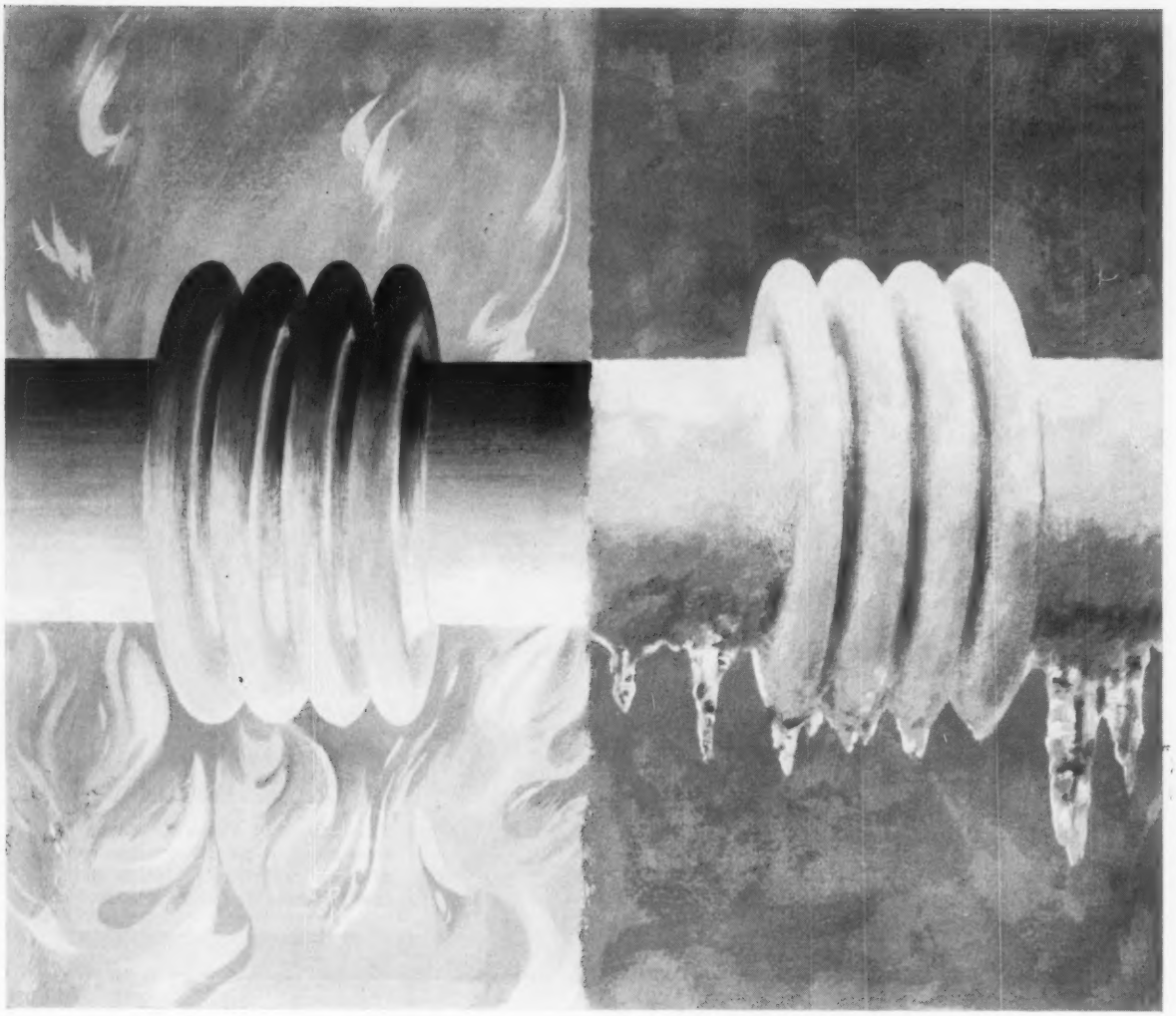
A Koppers engineer can show you how Fast's Couplings will give you extra years of service and reduce down-time. For more details, write to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 3306 Scott Street, Baltimore 3, Maryland.

Koppers Company, Inc.
Metal Products Division
Baltimore 3, Maryland

Engineered **Products**
Sold With ***Service***

KOPPERS

THE ORIGINAL
FAST'S Couplings



HOT OR COLD

Sola-Flex® joints are designed for temperature extremes

FROM LIQUID OXYGEN at –300 F, to extremely hot materials at 2000 F, Sola-Flex bellows and expansion joints are engineered for long periods of rugged service under severe temperature extremes.

In cold oxygen lines, Sola-Flex joints reliably handle high pressures in extended positions and the U-span design offers no internal pockets to conceal dangerous contaminants. In high temperature applications, Sola-Flex joints require no external reinforcement rings, provide an economical solution to expansion problems.

Hot or cold, large or small, high pressure or low—no matter what your particular piping need, experienced Solar engineers can recommend exactly the right expansion joint for you. Write today for the latest Sola-Flex catalog. Department D-33, Solar Aircraft Company, San Diego 12, California.

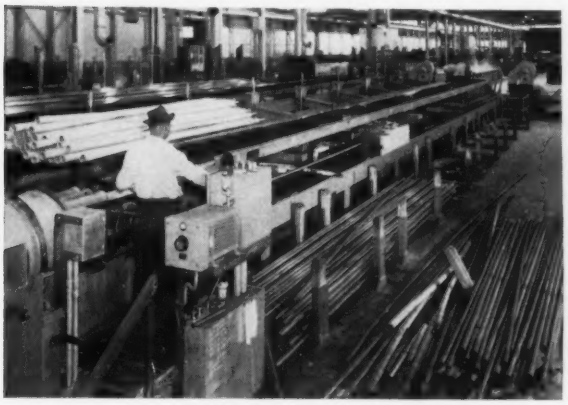
Sola-Flex Bellows and Expansion Joints for industry are designed and manufactured by Solar Aircraft Company

SOLA SOLAR FLEX®

Here's why you get that extra measure of performance from **BRIDGEPORT** condenser tubes

1 ELECTRONIC SPECTOGRAPH analyzes the composition of alloys from which condenser and heat exchanger tubes are made. From the very beginning, product performance and customer satisfaction are essential. Maintaining high metallurgical standards means high tube quality—it starts here.

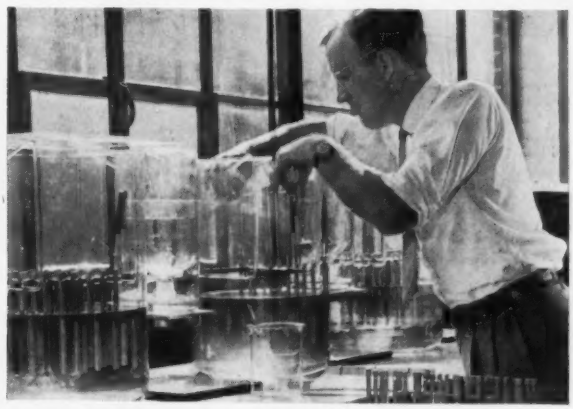
From spectograph to shipping, every step of Bridgeport Condenser Tube manufacture is carefully and closely controlled. Research, experience, skill and attention to your individual needs are integral qualities of every Bridgeport Condenser Tube that pay off in performance. Put them to work for you by calling your local Bridgeport Sales Office.



2 MODERN DRAW BENCH (its size speaks for itself) and others of the same "caliber" bring copper, alloy condenser and heat exchanger tubes down to exact, uniform dimensions.

3 HIGH-TEMPERATURE ANNEALING FURNACES give tubes the proper physical characteristics.

4 CLOSE INSPECTION of diameter, wall thickness and surface finish is made—another step that assures you that your Bridgeport tubes are made to flawless standards.



5 CORROSION RESEARCH is continuous at Bridgeport Corrosion Laboratories. Here the many alloys used under all corrosive conditions are tested; new alloys are developed from the knowledge and experience acquired here and in the field.

BRIDGEPORT CONDENSER TUBES

Bridgeport Brass Company • Bridgeport 2, Conn. • Offices in Principal Cities

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CRUSHPROOF...LEAKPROOF...FLEXIBLE FOR HANDLING VOLATILES...GASES

PRESSURES TO 200 PSI . . . SWIVEL FLANGE FOR EASY INSTALLATION

Stainless steel lined metal hose for rugged flexibility . . . covered with tough rubber for absolute leakproof security . . . that's Penflex Suction and Discharge Hose. It's lighter in weight than any other comparable competitive hose . . . easy to handle with swivel flange that allows installation in any position without turning entire hose to meet bolt holes. End fittings are made of steel to meet specifications of refinery engineers.

Penflex Suction and Discharge Hose has been thoroughly tested and is used by leading refineries and chemical plants throughout the nation. It is proved and approved the all-purpose hose for oil, gasoline, solvents, corrosive chemicals and other volatiles and liquids. Available in sizes 2″ to 12″ I.D. in galvanized steel, stainless steel and bronze pressure carrier. Write for complete details.

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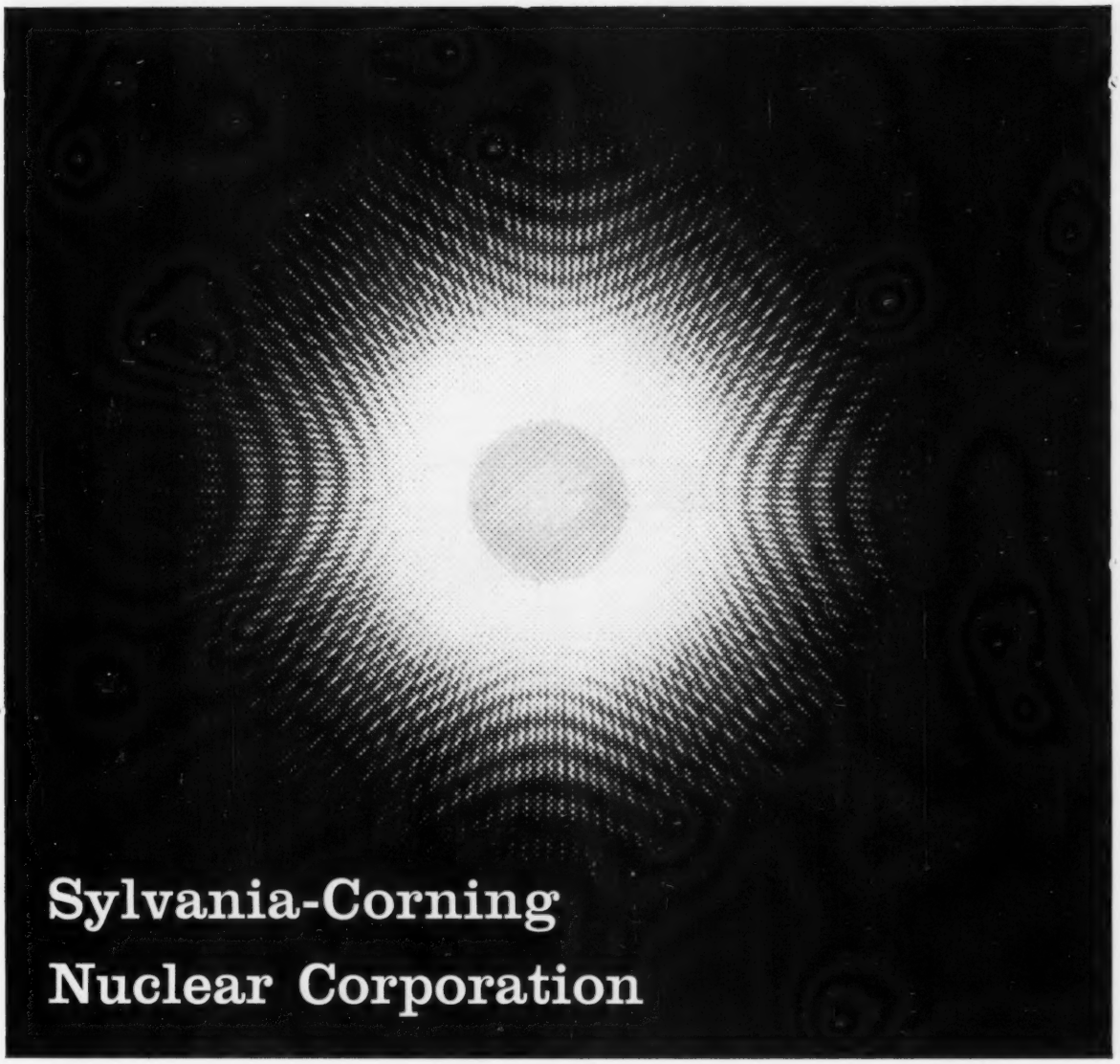


The world's first atomic fuel company

Now that the energy of the atom is being successfully harnessed to commercial uses, the world is rapidly moving ahead to exploit this huge source of power. Several nuclear power plants are already producing electricity. Many more are being built the world over.

To supply the growing need of these atomic power plants for any type of nuclear fuel, Sylvania Electric Products Inc. and Corning Glass Works have formed the jointly owned Sylvania-Corning Nuclear Corporation. Through specialization in the design, fabrication and processing of nuclear fuels, the Corporation's aim is to provide complete and continuous service to all of the users of nuclear fuels.

Sylvania's Atomic Energy Division brings to the new corporation more than eight years of experience in the design and fabrication of atomic fuels and fuel recovery processes. Corning Glass Works has pioneered in the development of high-temperature ceramic nuclear fuel elements.

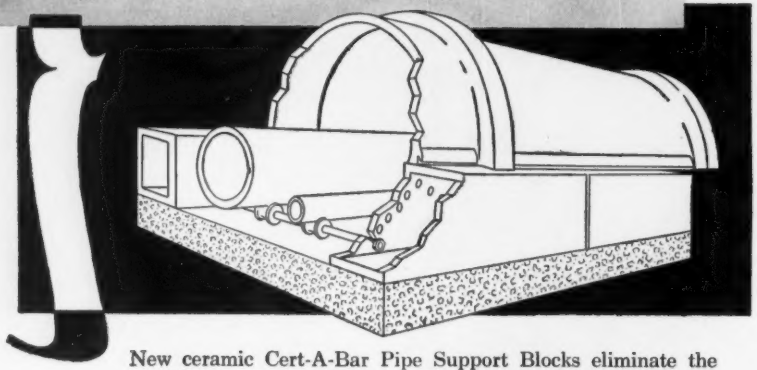
The nuclear energy activities of both companies have become the Sylvania-Corning Nuclear Corporation, the only company devoted exclusively to the development and supply of nuclear fuels.

For more complete information on this new organization, write to the address below. The combined scientific, engineering, and technical staff will be glad to help you solve any problems you may have in nuclear fuel application—whether immediate or in the planning stage.

SYLVANIA-CORNING NUCLEAR CORPORATION, Bayside, N. Y.

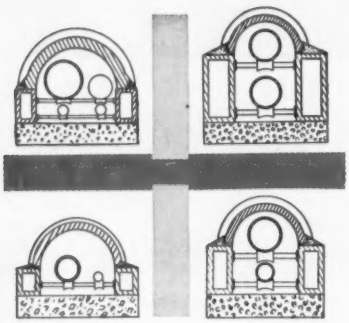
PERMANENT PROTECTION
for underground piping!

STILLWATER CERT-A-BAR* TUNNEL CONDUIT SYSTEM



New ceramic Cert-A-Bar Pipe Support Blocks eliminate the need for interior cast iron rests. The perforated block is laid as a structural support member at regular intervals, and the bars are simply inserted and locked in place.

THE vital consideration in selecting an underground conduit system is *permanent* protection . . . not for one year or five, *but for the life of the piping.* You get the best possible protection for your underground metal service piping with a Stillwater Conduit System of vitrified clay. It's chemically inert—can't rust, rot, corrode, or decay . . . ever. And it is manufactured in accordance with ASTM specification C-13-54, assuring proper strength and quality. Any combination of service piping can be protected. Conduit is available in a wide range of sizes, with a complete line of fittings and accessories, including alignment guides, lateral guides, and anchors. Any contractor's crew can handle the installation easily, or if you prefer, Stillwater Licensed Installers will assume the responsibility. The Cert-A-Bar Tunnel System can be installed with any of three suggested new waterproofing specifications —one for average conditions, one for intermittent ground water conditions, and a third for high water table conditions. It's the lowest-cost conduit per year of service that you can specify or install!



THE CERT-A-BAR SYSTEM HAS ALL THESE IMPORTANT ADVANTAGES

- Inherent structural strength for permanent protection
- Complete flexibility for design
- Minimum initial and long-term costs
- Quickly installed
- Keeps pipe insulation dry
- No electrolytic corrosion of piping
- No maintenance required

A few of the hundreds of possible combinations of piping for the Cert-A-Bar Tunnel System are shown at left.

WRITE FOR

illustrated, four-page circular with complete installation specifications.

*T.M. Reg. App. For. Patents Pending

The Stillwater Clay Products Co.
STILLWATER CONDUIT DIVISION
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SW-956-70A

STILLWATER CONDUIT SYSTEMS

The caliber of the companies and variety of products represented here is ample proof of Speedline's versatility—when it comes to process piping.

Learn how the unique features of Speedline Stainless Steel Fittings can benefit you—wherever corrosion or contamination is involved. The combination of Speedline Fittings and light wall Schedules 5 and 10 stainless pipe simplifies design and assembly—thus reducing installation time and material costs.

Write for your free copy of new Speedline Catalog today or contact your nearest Speedline Distributor.

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Speedline

STAINLESS STEEL FITTINGS

THE NEWEST THING IN PIPELINE ECONOMY

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SPEEDLINE IS A REG. T. M. OF HORACE T. POTTS COMPANY

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Powers' service allows complete freedom of temperature control planning and installation, too, for Powers Controls are available on an installed basis or as equipment only. Call your local Powers branch today for the full story, or write to:

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Skokie 24, Illinois • Department 657

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to keep liquids ON-THE-LEVEL

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- Really automatic liquid level control . . . proven by a 40-year record of dependability in thousands of installations, large and small, water and chemical.
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- Also available with Klipfel's exclusive cup disc inner valve for tight control of liquids injurious to rubber and leather, and for higher pressures.

Get all the facts today on versatile Klipfel Float Valves.

Write for catalog #254.

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• BACK PRESSURE VALVES
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Division of Hamilton-Thomas Corp.
Dept. A-6, Hamilton, Ohio

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Equipto modern-flow Benches

161 MODELS TO CHOOSE FROM

Now you can custom design your own layout with Equipto modern-flow Benches. They can be easily arranged into one continuous streamlined assembly.

Many types and styles of drawers, drawer pedestals, cabinet pedestals, sliding doors, aerial shelves and accessories are available for Equipto Benches.

All Equipto modern-flow Benches are available with a choice of four tops . . . 12 gauge steel top, masonite covered steel top, resinwood or laminated maple top.

Send for big 16 page catalog No. 200 illustrating and describing this outstanding line of top quality benches.

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Steel Shelving . . . Parts Bins . . .
Drawer Units . . . Lockers . . . Carts . . . Work Benches

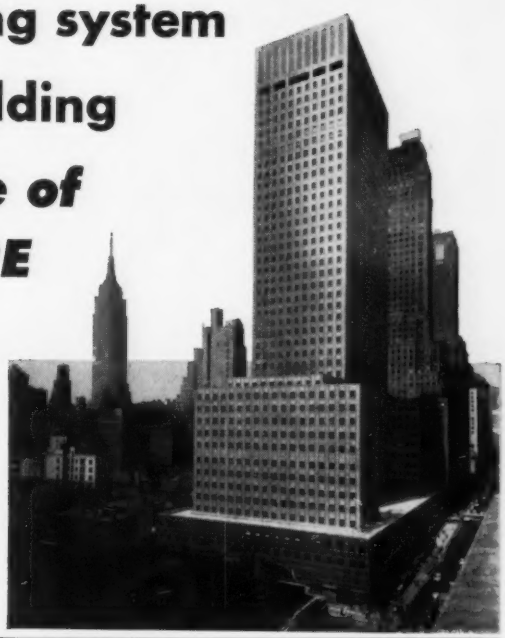
Coming in September

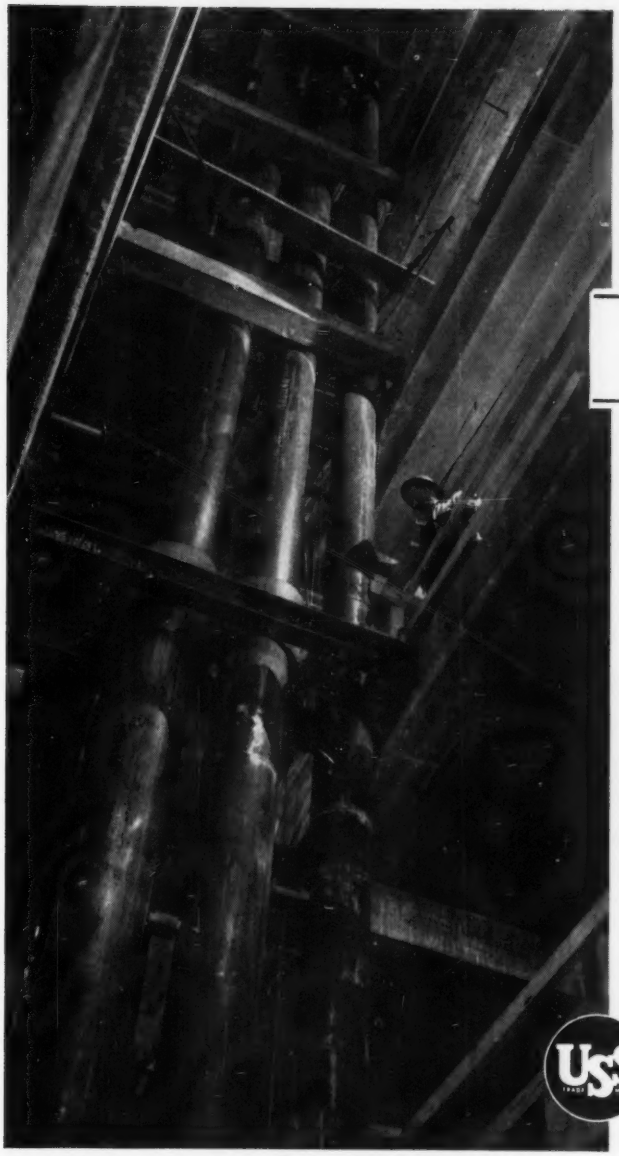
* * *

Power's 75th ANNIVERSARY ISSUE

WATCH FOR IT!

Ingenious air-conditioning system of Socony-Mobil Building *makes liberal use of* NATIONAL PIPE





Owner: GALBREATH CORP., JOHN W. GALBREATH AND PETER B. RUFFIN
Architects: HARRISON & ABRAMOVITZ
Associated Architect: JOHN B. PETERKIN
General Contractor: TURNER CONSTRUCTION COMPANY
Mechanical Engineers: JAROS, BAUM & BOLLES

This gleaming, 45-story, stainless-steel-sheathed building is the largest air-conditioned office building structure ever erected. Its remarkable air-conditioning system is powered by purchased steam, which is actually used twice. In the basement there is a refrigeration plant, consisting of 3 centrifugal steam turbine driven compressors of 2600-ton capacity. These 3 units are driven by steam turbines operating full condensing, with the exception of one which is a partial condensing and exhaust. This exhaust steam, by means of a 10-inch steam main, is tied in with the building's steam distribution system. This 10-inch main serves, during summer operation, all the steam requirements for the tempering coils in the air-conditioning system, as well as the steam required for three 500 Lithium Bromide Absorption Machines. In other words, the three 500-ton units act as a surface condenser for the exhaust steam—the building enjoying the economics of this ingenious piping layout.

Approximately 470 tons of USS NATIONAL Pipe—most of it Seamless—were used in the construction of the air-conditioning and heating systems. And at least 350 tons of NATIONAL Seamless were used in the huge building's plumbing system.

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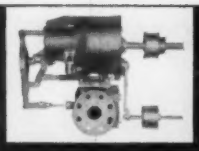

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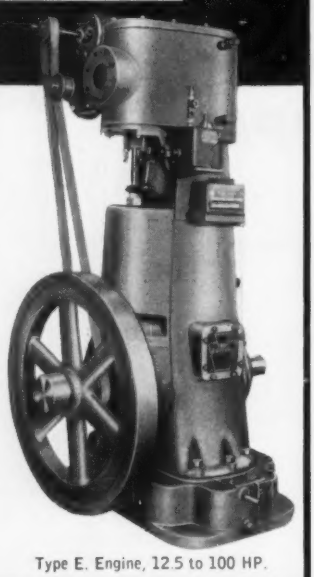

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New EASTERN CAR SHAKERS

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Write for Bulletin 550

EASTERN CONSTRUCTORS, INC.
Poland, Ohio

Note ease of handling of 3/c 5kv Okolite-insulated power cable.

Edward E. McIlveen, Okonite's Assistant Manager of Engineering shows:

Why Loxarmor is the low cost alternative to conduit

Rubber-insulated Loxarmor Interlocking S-shaped armor cables provide an ideal combination of flexibility, light weight and mechanical strength. Where rigid conduit is not desired, Loxarmor is the No. 1 alternative for either power or control circuits. Here's why:

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Circuits are easily added or re-routed—usually trained in trays or racks, Loxarmor cables can be easily moved.

Easy accessibility reduces down-time—permits quick inspection. Can be installed indoors and outdoors.

Loxarmor occupies less space—not much more than half the space is required for multiple Loxarmor circuits vs. circuits in conduit.

Loxarmor can be supplied with the strip-insulated insulations Okolite oil-base or Okonex butyl-base; with extruded Keystone or Watertite insulations; or with varnished cambric—all depending upon your installation conditions and voltage requirements.

Loxarmor is available in galvanized or stainless steel, aluminum, bronze or copper armor. May be obtained with either copper or aluminum conductors. For further information write for Bulletin PW-1090. The Okonite Company, Passaic, N. J.

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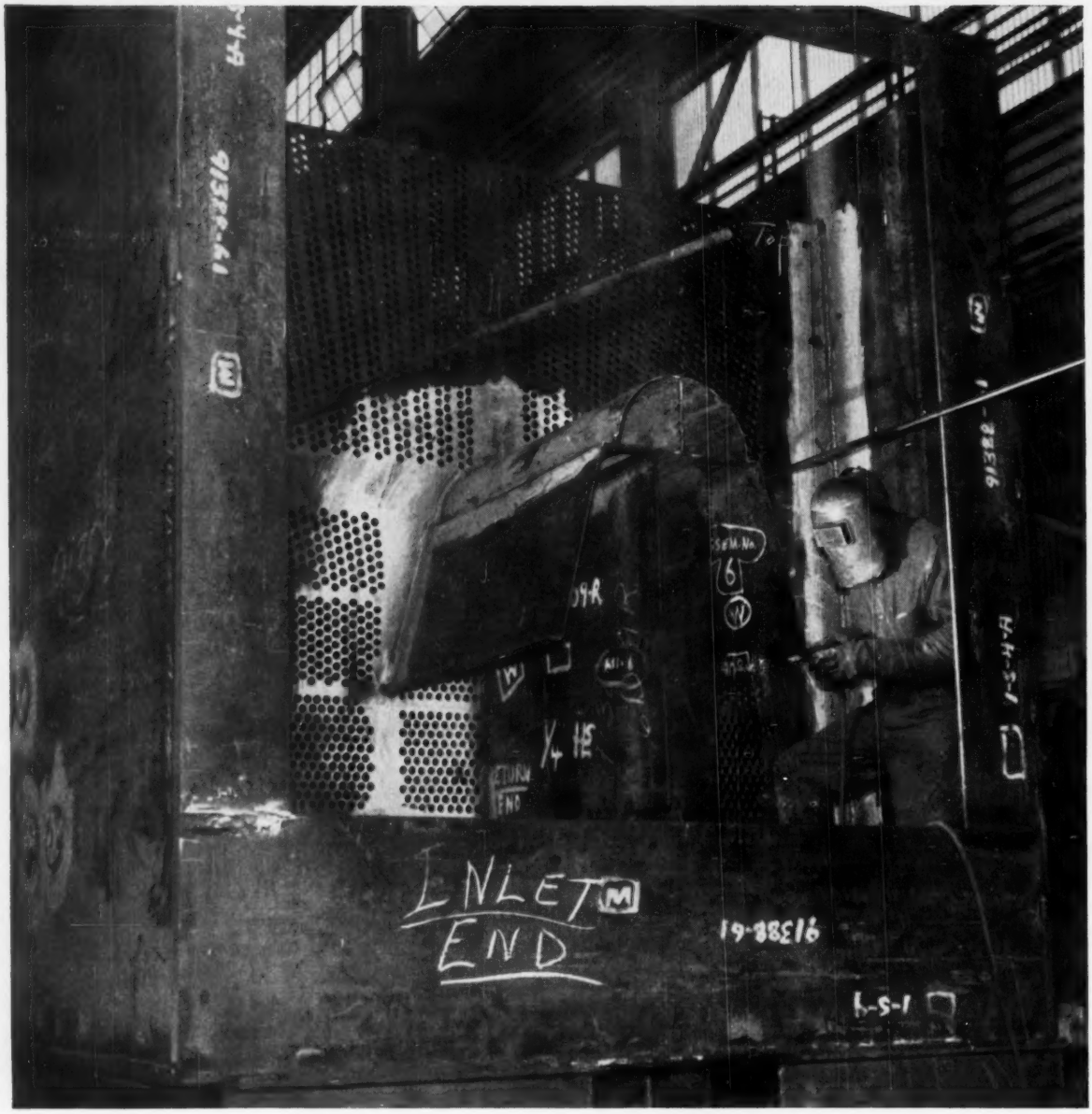

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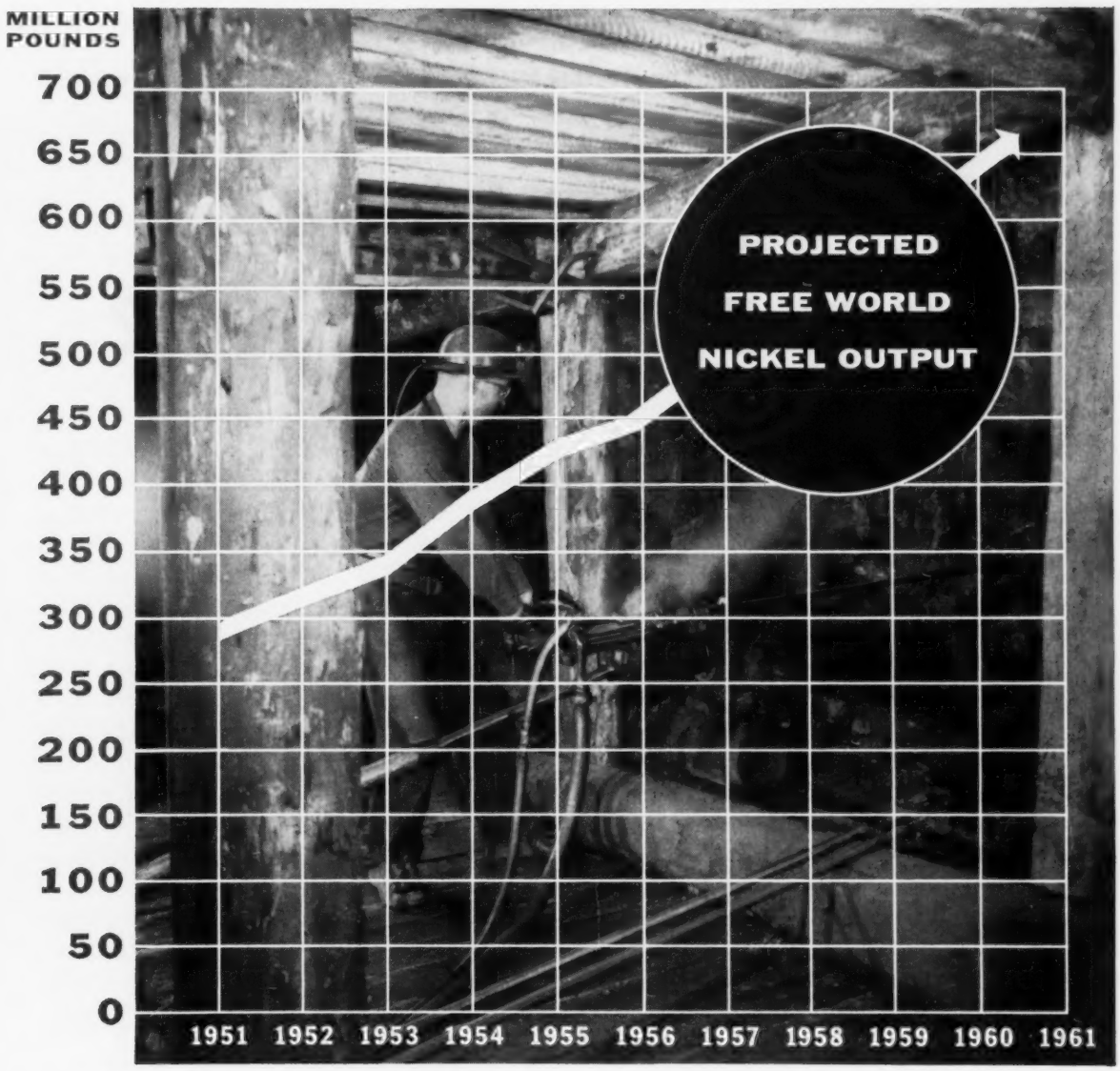

Another 50% advance in nickel industry's production capacity

Paced by Inco-Canada's new developments in Manitoba, producers put 1961 Free World nickel output at 650-675 million pounds a year—up 130% over 1951

In 1951, the nickel industry of the *Free World* produced about 290 million pounds of nickel.

Last year, the over-all output of the industry set a new record high of 450 million pounds.

This was an expansion of more than 50% in five years: a substantial production boost that indeed benefited industry, but only after vital defense and government stockpile needs were given preference.

New Inco-Canada developments help set new goals

Right now Inco-Canada, with years of exploration behind the project, is pushing construction at its new Manitoba mines: developing in the far North a new, big-tonnage nickel-producing area.

In Ontario, at the same time, Inco-Canada is continuing to expand its Sudbury capacity.

In 1961, this should lift Inco-Canada's nickel output to 385 million pounds a year. A hundred million more than in 1956!

With the steadily increasing capacity of all *Free World* producers, in the next four years nickel production should be lifted to the all-time high of 650-675 million pounds a year.

With 1961 capacity anticipated at more than twice what it was in 1951—and with continuing exploration—nickel users are assured of more nickel in their future.

The International Nickel Company, Inc., New York 5, N.Y.

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INCO **International Nickel**

The International Nickel Company, Inc., is the U. S. affiliate of The International Nickel Company of Canada, Limited (Inco-Canada)—producer of Inco Nickel, Copper, Cobalt, Iron Ore, Tellurium, Selenium and Platinum, Palladium and Other Precious Metals

Can We Afford a $71.8 Billion Budget?

THE BUDGET submitted to Congress by President Eisenhower for the year beginning July 1 proposes federal spending of $71.8 billion. In only four years, three during World War II and one during the Korean War, has the government spent more. Under the proposed budget the government expects to collect $73.6 billion, mostly through individual and corporation income taxes.†

The principal reason for the size of the budget and for this year's increase is an expanding defense program. About 60% of all budget expenditures in the coming fiscal year will be for national security programs. Moreover, this area accounts for about 90% of the proposed increase in federal spending. In addition, as the chart shows, there are large expenditures proposed for purposes other than defense.

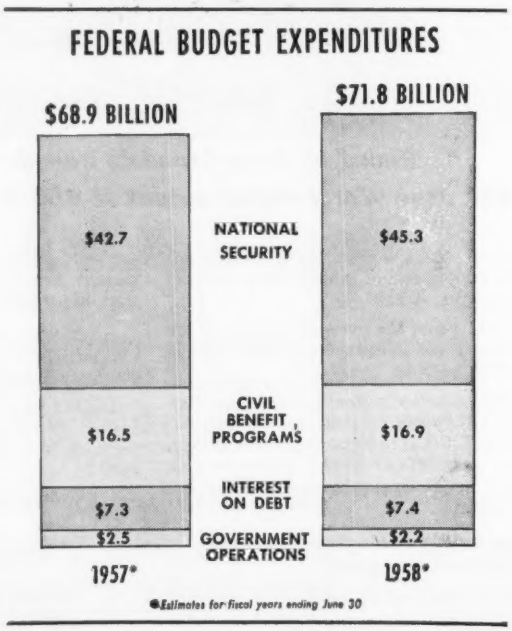
Continued budgets of this size, some contend, will lead to inflation and wreck our economy. It has been suggested that they might lead to "a depression that will curl your hair." Yet many insist that the budget, large as it is, still is inadequate in many respects — for defense, schools, agriculture, small business, health, research, indeed, for almost every activity in which the government has become involved.

Is It Really Too Big?

Actually, the proposed budget would place no greater burden on the economy than any budget in the last six years, because our economy has been growing. Federal spending per capita under the proposed budget will be about $416, or $10 more than this year; but our per capita income rose almost $80 last year. And, because of our increasing population, next year's expenditures will, in fact, amount to *less* per capita than in 1954 when federal spending was $4 billion lower.

Another way of measuring the burden of government expenditures on the economy is to compare the purchases of goods and services of all branches of government — federal, state and local — with the total output of the nation. The share of our national product taken by government this year will be about the same as in the past two years and, furthermore, about the same as the average for the past 28 years.

By the standard of any recent year, the budget is within the means of the American economy. In this sense, we can "afford" it. But the pros-



†*These figures refer to the regular federal budget and do not include operations of trust funds, primarily for social security programs and the new federal aid program for highways, which are financed by special taxes.*

pect of steadily increasing budgets, requiring 20% or more of our national income, introduces another threat.

The Real Threat

Large and rising budgets that do not balance government spending with higher tax collections clearly would be inflationary and would destroy the value of the savings and income of all who lagged in the race with climbing prices. But serious dangers will still exist even if our budget continues to be balanced, as this year's is.

- **Budgets that require a large take in taxes eat up the savings required to finance private industry.** What the taxpayers must give the government they cannot save. This deprives private industry of the savings and resources needed to expand and modernize producing facilities.
- **High tax rates also undermine the incentive to save and invest in normal business enterprises by taking such a large share of any income gained.** Taxes on corporation income now take 52% of all income over $25,000. And taxes on individual incomes can take as much as 90% of earnings that remain after this 52% bite.
- **High taxes encourage, on the part of both individuals and corporations, the search for "gimmicks" and special treatment.** As a leading character in Cameron Hawley's novel *Executive Suite* observed: "To a far greater degree than most people realize, income tax has become a primary governing factor in corporation management." Indeed, it is only because of the numerous gimmicks and special provisions now available that high tax rates have not already inflicted greater damage to economic incentives.

These dangers comprise the real threat of large and rising federal budgets. It is a threat to continued growth of our economy, and it is no less a threat merely because the budget is technically in balance.

What Should Be Done?

In attempting to hold government spending within reasonable bounds, we should *not* hold back on needed civilian programs. The heavy demands now being urged at all levels of government for roads and schools, for instance, are largely the result of failure to keep pace with the growth of the country. Furthermore, we cannot cut provisions for national security below the minimum level of safety. And unhappily, defense in the rocket and missile age is fantastically and ever increasingly expensive.

What we *can* do is enforce some financial discipline on our military leaders, and hold down our defense expenditures by making sure their demands are justified and by requiring efficiency. In the civilian programs, though some need to be increased to serve a growing economy, we can eliminate the outright waste.

A More Difficult Job

We must also do something far more difficult, and that is to reduce federal programs of aid to special groups at the expense of all the taxpayers. The new budget calls for over $5 billion for veterans, and another $5 billion for farmers. A number of industries and areas stand to receive aid in large amounts based less on necessity than on political pressure. These demands for increased aid, year after year, must be resisted if we are to have any hope of stopping a relentless rise in our budget.

Then, as our national income increases, we can look forward to reducing tax rates and providing greater incentives for the private sector of the economy. **Only in this way — by keeping government spending in line with economic growth — can we prevent our federal budget from being a crippling burden.**

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170	Cr. Wh.	151-H	230	500
150	Whse.	SK-184	230	850
150	C.W. TEFC b.b.	83H	230	830
100	Reliance	651-T	550	1600/1600
100	Elliott b.b. T.E.	JH-FE	230	1150
75	Century	R-92	230	690/1350
75	Reliance (3)	985-T	230	450/1200
60	G.E. TEFC b.b.	CD-135	230	1150
50	Gen. Elec.	CD-95	230	1800
50	Star b.b.	SQ-92	230	680
50	G.E.	CD-125	230	400/1200
50	G.E.	RF-16	230	250/1000
40	G.E. (2)	CD-93	230	1750
30	Whse. (2)	SK-151	230	250/1000

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200	Whse.*	220/440 AC	55 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	Whse.	2300 AC	250 DC
175	Gen. Elec.	220/440 AC	250 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
100	Gen. Elec.*(2)	220/440 AC	250 DC
75	G.E. converter	440 AC	250 DC
75	G.E.	220/440 AC	125 DC
60	Whse.	220/440 AC	250 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Cr. Wh. b.b. (2)	220/440 AC	250 DC
30	G.E.	220/440 AC	125 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
150	Whse.	SK-184	250	1150
150	Cr. Wh.	CCD	250	650
100	Allis Ch.	E	125	1200
100	Reliance	651-T	600	1200
75	Century	R-92	250	900
60	Allis Ch. (3)	E-146	250	1500
60	Ideal	D	125	1150
45	Allis Ch.	E-123	250	1800
35	G.E.	RC-34	125/250	900

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HP	Mfr.	Type	Volts	Speed
600	G.E.	Slipring	2300	600
500	Whse.	Slipring	2300	450
400	Whse. (2)	Synch.	2200	1800
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2200	3600
400	Whse.	Sq. Cage	2300	900
400	G.E. (2)	Slipring	440	900
350	G.E.	Sq. Cage	2200	1800
350	Cont. b.b.	Slipring	2300	900
350	G.E.	Slipring	440	1200
350	Allis Ch.	Slipring	2200/400	600
300	Whse.	Synch.	440	1200
300	G.E.	Slipring	440	450
300	Allis Ch.	Sq. Cage	2200/440	720
250	Ideal	Slipring	2200	900
250	G.E.	Slipring	440	1800
250	G.E.	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Slipring	220/440	720
250	Gen. Elec.	Synch.	220/440	450
250	Whse.	Slipring	440	1200
250	G.E.	Sq. Cage	2200	1800
225	G.E.	Synch.	220/440	900
200	G.E. (2)	Sq. Cage	2200/440	1200
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200	Allis Ch.	Slipring	440	450
200	Allis Ch.	Slipring	2200/440	720
200	Cr. Wh.	Sq. Cage	2200/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G.E.	Sq. Cage	440	600
175	G.E. (2)	Synch.	220/440	720
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150	G.E.	Slip Ring	220/440	450
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2	250	West.		1	2300/4600-230/460
3	200	West.	S	1	2400/4160-240/480
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3	200	G.E.	H	1	7800/15600-220/440
1	150	Eisler	OA	1	4160-240/480
2	3000	Maloney	TCR	3	7200/6600-4160/2400
3	50	Niagara	Air Cld	1	2300-120/240
2	37½	West.	Hypersil	1	2400/4160-240/480
4	25	West.	Hiperiol	1	2400/4160-120/240
3	15	West.	H Pyranol	1	6900/11950Y-120/240
6	15	Maloney	KL	1	2400/4160Y-120/240

SYNCHRONOUS MOTORS

Qu	HP	Make	Speed	Type	Volts
1	100	G.E.	900	TS	2300
1	125	G.E.	600	TS	2300
1	125	E.M.	900		4600
1	150	G.E.	1800	TS	220/440
2	150	Allis-Ch.	360		2200
1	150	West.	900		220
1	300	E.M.	720	TEFC	2300
1	500	West.	450	HR	440
1	1000	West.	360	Mill	2300/4150

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
1	15	G.E.	900	MT-542	440
1	25	G.E.	900	MT-526	440
1	60	G.E.	1800	MT	220
1	60	Ideal	900	AY	220
1	75	G.E	600	IM	440
3	150	Allis-Ch.	1800	AY RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300

SQUIRREL CAGE

Qu	HP	Make	Speed	Type	Volts
1	25	G.E.	1170	405TEFC	220/440
1	40	Wagner	1750	CPI-444 TEFC B.B.	440
2	75	West.	1180	CS-607	440
1	100	G. E.	1775	KTP-543	440
1	40	Wagner	1200	CPI-445 TEFC B.B.	440
1	150	G.E.	720	KT-562	440
2	250	G.E.	1790	K.T.E.F.C.	2300
1	275	G.E.	1200	KT559BS	2200
2	300	G.E.	1800	K-4150V	new
1	400	Cont.	1200	N806S	2300

MOTOR GENERATOR SETS

Qu	K.W.	Make	Speed	Volts DC	AC
1	10	G.E.	1800	125	220/440 A.C.
3	60	E.M.	1200	125	220 v. Syn.
1	150	Cr. Wh.	600	125	220/440
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y S.R
1	1000	West.	720	600	2300/4160Y

D.C. 230 VOLT MOTORS

Qu	HP	Make	Speed	Type
1	75	C.W.	900	WP
1	125	G.E.	1700	RC
2	150	C.W.	900	WP
1	250	Allis Ch.	1750	FBL149BB

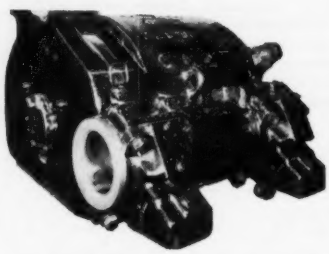
A.C. HOIST MOTORS

Qu	HP	Make	Type	Speed	Volts
1	35	G.E.	MTC	505	440
2	200	G.E.	ITC-5017	600	440

"FOR POWER"
J.L. HEMPHILL & CO.
1603 54th STREET, NORTH BERGEN, N.J.
PHONE NEW YORK—LONGACRE 5-3227
PHONE NEW JERSEY—UNION 7-1600

WESTINGHOUSE TRACTION MOTORS

New Original Crates



Westinghouse type 970-A; part No. 1296204. Max. HP: intermittent—400 HP at 550 volts—650 amps. Continuous with blower—300 HP at 308 volts—325 amps. Max. volts 550 DC—max. amps. 650—max. RPM 2000. 4-Pole series motors. Cooling: Can be force ventilated with small centrifugal fans. Air required, 1400 CFM at 1.3" static pressure. Originally designed for Whitcomb 65-ton diesel electric locomotive.

THE BOSTON METALS CO.
313 E. BALTIMORE STREET
BALTIMORE 2, MD. LE. 9-1900

STEAM GENERATORS

CAPACITY EACH — 60,000 LBS. STEAM PER HOUR

Manufactured by Foster Wheeler for the U. S. Navy. Two of these powered a Destroyer Escort Vessel. They can be outfitted for seagoing vessels; or are adaptable for industrial use where high temperatures and pressure are required.

New, never used, never erected. Stored indoors. 2 drum, 435 psi operating pressure, 740 deg. F. final steam temp., with superheater, economizer, fuel oil burners, soot blowers, valves and fittings. All accessories by well known manufacturers.

A tremendous buy over new manufacturers prices. Located at Utica, New York. Inspection and inquiries invited.

PELNIK-LOCONTI INDUSTRIAL SUPPLY CO.
Office Ph. Utica 6-4621 Yard Ph. Utica 2-4513
315 Oriskany Street, Yorkville, N.Y.

DIESEL GENERATOR SETS

2—McIntosh-Seymour (Alco) 950 HP 8 cyl. 225 RPM, 875 KVA Westinghouse 3 phase, 25 or 60 cycle alternators. 20 KW exciters.

1—McIntosh-Seymour (Alco) 600 HP 5 cyl. 225 RPM, 500 KVA General Electric 3 phase, 25 or 60 cycle alternator. 15 KW exciter.

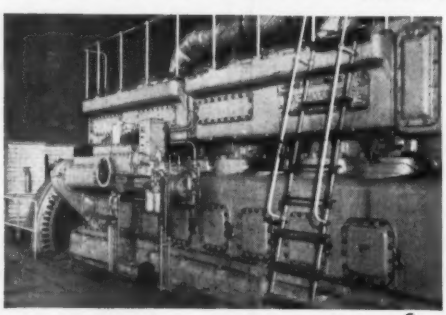
Complete plant installation with all accessories. Priced attractively. With or without generators.

WHISLER EQUIPMENT CO.
611 Olive St. • St. Louis 1, Mo.

MODERN SLOW SPEED DIESEL ELECTRIC GENERATING SET

OFFERED AT CONSIDERABLE SAVING

ALSO AVAILABLE
•
WORTHINGTON
BB5
100 KW
600 RPM
3/60/480
•
Other Sets from 20 KW to 1200 KW



COMPLETE WITH ALL AUXILIARIES
—
Other Sets from 20 KW to 1200 KW

FAIRBANKS MORSE MODEL 33F16
1125 KW 300 RPM 3/60/480V

NATIONAL METAL & STEEL CORP.
1251 NEW DOCK STREET TERMINAL ISLAND (LOS ANGELES HARBOR), CALIF.
CALL LOS ANGELES NEvada 6-9871
DIESEL DIVISION

FOR SALE

HEAT EXCHANGERS
FEED WATER HEATER

206 sq. ft. Surface—6 Water Pass

Working pressure: Shell 10 lbs., tubes 575 lbs. p.s.i.—Tubes: 210 ea. ⅝" O.D. .065" Gauge, 6'4" Long—Manufacturer: Struthers Wells—Shipping Weight: appr. 2300 lbs. O.A. appr. 26" dia. x 8'.

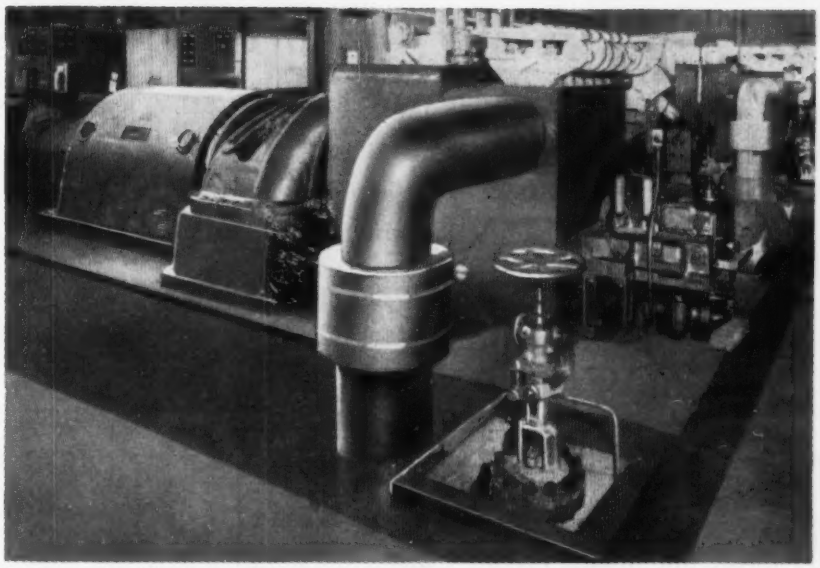
HUGO NEU CORPORATION
45 Nassau Street, New York 5, N.Y.
Tel. RE 2-1334

BOILER — UNUSED

Babcock & Wilcox 60,000 lbs./hr.—475 psi. boiler. CAN be shipped intact without dismantling. Standard trim. Immediately available at a fraction of original cost. Prints available.

WABASH POWER EQUIPMENT CO.
31 East Congress, Chicago, 5, Ill.
HA 7-4855

3125 KVA AUTOMATIC EXTRACTION-CONDENSING



The above Worthington-Crocker Wheeler Turbine-Generator is a modern unit. Turbine #5211, 250/300 PSIG, 750°FTT (good for 400# with changes) controlled extraction 15 to 50#, 30,000#/hr., 80% throttle flow extraction. Crocker-Wheeler Generator #892503, 3/60/ 13,800 V. with shaft-driven Exciter, Surface Condenser with all auxiliaries.

CHARLES WEAVER

19701 James Couzens Hwy. Tel: BRoadway 3-1901 Detroit 35, Michigan

---

20,000# SPH, 200# WP, Pck. Type Boiler
538 KVA Generator dir. con. Diesel-oper.
24"—30"—42" & 48" Belt Conveyors
426 HP, 180# WP B&W Water Tube Boiler
60 HP Vertical & 60 HP Horiz. Boilers
60' & 80' x 160' x 20' Steel Buildings
400 HP 160# & 300# WP Sect. Hdr. Boilers

H. & P., 6719 Etzel, St. Louis 14, Mo.

DIESEL ENGINES — POWER MACHINERY

100 KW to 1500 KW

Diesel Generator Sets • Stationary • Portable • Mobile Motors and Generators

A. G. SCHOONMAKER COMPANY, INC.

MAIN OFFICE: Box 516, Sausalito, Calif. Sausalito 1600 **BRANCH: 50 Church St., N. Y. 7, N. Y. Digby 9-4350**

AIR COMPRESSOR

Ing.-Rand 14½" x 14½" x 10", Type XRE, low press. 35#, 1370 CFM, 1 stage, 360 RPM, W/150 H.P. Whse. sync. motor 3 ph., 440 V., shaft mounted, new 1952, fully complete.

Further inf. upon request.

PHILADELPHIA TRANSFORMER CO.

Box 566 • Dalton, Pa.

FOR SALE
18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16". to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.
Will sell turbines separately if desired. *Price reasonable.*
Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

G. M. DeROSE
2457 WOODWARD AVE.
408 DONOVAN BLDG.
DETROIT 1, MICH.

MODERN POWER PLANT

1875 KVA WORTHINGTON MOORE TURBINE 400 PSI, 700°F Condensing, driving 2300 Volt CROCKER WHEELER GENERATOR 25000#/Hr. 450 PSI, 738°F, Coal Fired BOILER; includes all auxiliaries, controls, 25 Ton powerhouse crane and coal handling facilities.

WATER SOFTENING PLANT

COCHRANE Feed Water Heater and Softener complete with demineralizer, cation and anion exchangers, regenerating equipment, decarbonator, sedimentation tanks, filters, controls, etc. to deliver 24000 GPH hot soft water.

OVERHEAD CRANE

120 ton SHEPHARD NILES 69'5" span, 37' lift, 6 motors, 3/60/440V (2) 60 ton trolleys, 1 with 10 ton aux. hook.

SYNCHRONOUS MOTOR

700 HP, 4150/2400V, 514 RPM.

80000#/HR. BOILER

ERIE CITY Type 1-W-T BENT WATER TUBE 3 drum 250 PSI W.P.; Built 1948; 8100 sq ft. heating surface; 1370 sq. ft. water wall surface; steel encased; Rotograte spreader stoker; forced and induced draft fans; dust collectors; Thermix stack. Used only 2 years.

75000#/HR. BOILER

COMBUSTION ENGR. CO. 4 drum STIRLING Type BOILER 400 PSI W.P.; pulverized coal fired; forced and induced draft fans; superheater, waterwalls.

400 HP BOILER (2)

B&W 160 PSI Oil & Gas fired ASME, New 1947.

DIESEL GENERATOR

COOPER BESSEMER 8 cyl. JS8GD, 13" x 16", 400 RPM, direct connected to 500 KVA 3/60/2400-4160V Generator.

Send Us Your Surplus Lists

HEAT & POWER CO., INC.

60 E. 42nd St. • Murray Hill 7-5280 • New York 17, N. Y.

(Machinery & Equipment Merchants)

HIGH PRESSURE TURBINE-GENERATORS

IMMEDIATELY AVAILABLE

1—10,000 KW at 70% P.F., 600 PSIG, 750 Deg. FTT, 12,000/13,200 V. Installed 1947.

1—2500 KW 80% P.F. 250# Aut. Ext. 50# Condensing, 3/60/13800.

1—3000 K.W. 400# Condensing, 3/60/2300/4160.

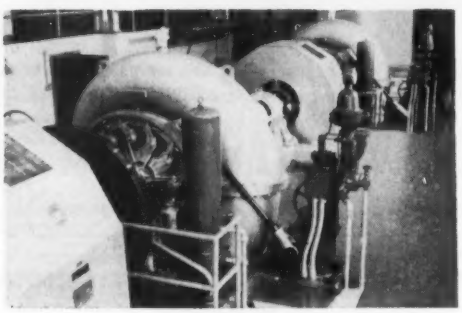
Complete with Surface Condensers and all Auxiliaries.

CHARLES WEAVER, M.E.

19701 James Couzens Highway, Detroit 35, Michigan

Telephone: Broadway 3-1901

TWO 1,500 KW HYDRO ELECTRIC PLANTS



2000 HP Pelton type Turbines, 160 ft. head, 600 RPM, 4160 Volt, 3 Phase, 60 Cycles, .8 PF, Direct connected excitors, complete modern cubicle. Three 1250 KVA Transformers 66,000-38,150-4160 Volt, and taps. Plants were in service less than four years and are in new condition. Immediate delivery.

GENERAL MACHINERY LIMITED

GRANVILLE ISLAND **VANCOUVER, B. C.**

1875 KVA NON-CONDENSING ELLIOTT TURBINE GENERATOR

400 PSIG, 750° FTT (with changes), was operated at 250 PSIG, 35/75 PSI Back Pressure, 600° FTT, 197.4° FSH. Generator, 1875 KVA, 1500 KW, 80% PF, 3/60/480, Direct - connected Exciter, Switchboard. Complete Set in exceptionally good condition. New in 1946.

Immediate Delivery

Full information furnished on request

DELL STEPHENSON & COMPANY

14456 Glastonbury, Detroit 23, Mich.

Phone: Vermont 5-0697

BOILERS

HI-PRESSURE

Complete stock from 10-2,000 hp.p
Nation's largest inventory. New & Used.

WABASH POWER EQUIPMENT

31 E. CONGRESS, CHICAGO 5, HA 7-4855

FOR — SALE

USED HEAT EXCHANGERS

Ross — #1920	670 Sq. Ft.
Ross — #2520	1257 Sq. Ft.
GR—Size 25-8-240	1280 Sq. Ft.
Alco—Size 27-192	1320 Sq. Ft.
Whitlock	2400 Sq. Ft.

FORCED DRAFT FANS

Sturdevant (NEW) 52000 CFM, Size 30½ with 200 H.P. Geared Turbine Drive. Westinghouse (USED) 21000 CFM, with 72 H.P. Turbine Drive.

SPECIAL

New Surface Condensers
Worthington 11,000 Sq. Ft.

NEW SURFACE CONDENSORS

Allis Chalmers	400 Sq. Ft.
C. H. Wheeler	436 Sq. Ft.
Foster-Wheeler	580 Sq. Ft.
C. H. Wheeler	725 Sq. Ft.
N. Y. Shipbuilding	2000 Sq. Ft.

NEW FEED WATER HEATERS

Struthers-Wells — 206 Sq. Ft.
(60,000#/Hour, 6-Pass.)

NEW LUBE OIL COOLERS

Ross #860	Ross #848
Alco #10-54	(75 Sq. Ft.)
Struthers Wells	(186 Sq. Ft.)

EASTERN SCRAP AND SALVAGE CORPORATION

65 MUIRHEAD AVENUE, TRENTON, N. J.

COMPRESSOR DIRECTORY

World's Best Rebuilts

138 CFM	100 PSI	7x7 Ingersoll ESI
184 CFM	135 PSI	8x9 Ing. Worth
268 CFM	500 PSI	10-4½x10 Ingersoll XOB
284 CFM	100 PSI	Chic. PE 50 HP
321 CFM	125 PSI	10x11 Worth HB
437 CFM	40 PSI	12x9 Ing ESI (New)
465 CFM	100 PSI	12x11 Ing ESI
552 CFM	100 PSI	13-8"x12 Ingersoll XRB
676 CFM	100 PSI	15-9½x12 Ing XRB
593 CFM	100 PSI	13½-8x8 IR-XRE
868 CFM	100 PSI	17—10x12 CP-OCE
1016 CFM	55 PSI	17x13 Ing ESI
1270 CFM	40 PSI	19x13 Ing. ESI
1723 CFM	110 PSI	140 lbs. st Ingersoll XPV

Portables—60 CFM to 600 CFM

American
AIR COMPRESSOR CORP
DELL AVE & 47th ST
NORTH BERGEN, N.J.
Telephone UNion 5-4848

BELYEA-RE-NU-BILT

LARGE ELEC. POWER EQUIPMENT SELECTED STOCK ITEMS

RE-NU-BILT—GUARANTEED—RE-NU-BILT COMBINATION MILL DRIVES— D.C. MOTORS WITH M.G. SETS & CONTROLS PACKAGE DRIVES IN STOCK

1—1200 HP G.E. MPC, 600 V. D.C. Motor, 450 RPM, and 1000 KW. G.E. M-G Set, 600 volt DC with 1400 HP, .8 PF, Synch. Motor 13200/6600 volt, 3 ph. 60 cy.

1—850 HP, G.E., Type MCF, 260 volt DC, 800/1200 RPM, and 675 KW., M-G Set, DC Gen., G.E., Type MCF, 260 volt, DC, with 1100 HP, .7 PF, G.E. Synch. Motor Type ATI 2300/4600 volt, 900 RPM, 3 phase 60 cycle.
Above with variable voltage control.

1—800 HP, Westinghouse Mill Motor, 300 volt DC, 250/550 RPM. Coupled to

1—800 HP United Gear Reducer ratio 7.04:1 with 750 KW G.E. M.G. Set, 300 V. D.C. with 1400 KVA Motor 13200/6600 V.
With magnetic DC Control.

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
2	1750	G.E.	M-579BS	4800/2400	1800
1	1500	G.E.	MT	6900	1187
1	1100	F.M. BB	SFS06S	4800/2400	1800
1	800	G.E.	MT	2300	293
1	750	G.E.	MT-573	2200	1190
1	700	Al. Ch.	D.P.	2300	500
1	500	Whse.	CW	550	350
1	400	Whse.	CW	440	514
1	350	Cr. Wh.	SIZE-71SR	208/406	1765
1	350	G.E.	IM-17A	440/2200	720
1	250	Cr. Wh.	MT-424Y	4000	257
1	250	G.E.	SIZE-290	2300	350
1	250	A.C.		550	600
1	200	G.E.	IM	2200	580
3	200	G.E.	IM	2200	435
1	200	G.E.	MT-557Y	2200	1760
1	150	Whse.	CW30E17	2300	435

SQUIRREL CAGE

1	800	G.E.	KT-573	2200	1180
1	650	G.E.	FT-559BY	440	3570
4	500	Whse.	CS 1216	2200	500
2	450	Whse.	CS-1420	2300/4150	354
1	400	G.E.	1K	2200	500
1	300	G.E.	KT-559A	2300	1775
1	200	G.E.	1K-17	440	580
2	200	G.E	KT-557	440	1800
1	150	Whse.	CS	440	580

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	4350	C.W.	3561-SL	13800/6900	514
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2000/2400	G.E.	450	250/300	2300/4600
2	2100	G.E.	514	250/300	2300/4600
1	2000	G.E.	514	600	2300/4600
1	1500	G.E.	720	600	6600/13200
1	1000	G.E.	900	260	6600
3	1000	G.E.	720	600	6600/13200
1	750	G.E.	720	275	6600/13200
2	1000	G.E	514	600	6600/13200
1	750	G.E.	720	125/250	2300/4600
1	500	Whse.	900	125/250	440
3	300	G.E.	1200	250	2300
2	300	Whse.		600	2300
2	300	Whse.	1200	600	2300
1	200	Whse.		550	2300
1	200	G.E.	1200	250	550/2300
1	200	Cr. Wh.	1200	250	440
1	150	Whse.	1200	275	2300

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
1	3000	G.E	OISC	3	23000x2300
1	1500	G.E.	PYRANOL	3 auto	4000/1200/4400
3	1000	G.E.	OISC	1	13800x460
2	750	G.E.	FUR	1	4800x85/55
1	833	G.E.	OISC	1	13800x460
3	500	KUHL	OISC	1	13800x6900

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
1	5000	G.E.	60/50/60	6600/11000/6600
2	2500	G.E.	25/62.5	2300/2300
1	1000	G.E.	25/58.3	4400/2300
1	500	Al. Ch.	25/60	11000/2300
1	200	G.E.	60/3000	440/800

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	10000	Whse.	Condensing 650 lbs. 750° F.T.T. Surface Condenser Dir. Conn. Exciter.
1	5000		Auto Extraction Condensing 650 lbs. 750° F.T.T. Auto.
1	1000	Moore	Auto. Ext. Cond. 17520# U.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300. Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 430/3/60.

BELYEA COMPANY INC.

43 Howell St., Jersey City 6, N. J.

GUARANTEED REBUILT POWER EQUIPMENT

HERE'S A WIDE SELECTION FROM OUR GIANT STOCK

SLIP RING MOTORS

3 Phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

HP	Make	Type	Speed
2500	*G.E.	MT	257
1200	*Al-Ch.	ANT	1800
600	*G.E.	MT	450
500	G.E.	M-6345	1200
300	G.E.	IM-17B	600
250	*G.E.	IM	720
200	G.E.	IM	600
200	Westg. (2)	CW	514
200	*Westg.	CW-905-A	514
150	Cr.-Wh.	50-R	1800
150	Westg.	CW	450
125	G.E. (2)	IM-15A	600
100	G.E.	IM-13A	1800
100	G.E.	MTC-5546	900
100	G.E.	IM	720
100	G.E.	IM	600
100	G.E.	IM-15A	450
75	G.E.	MT-347	1200
75	G.E.	IM	1200
75	Al-Ch.	ARY-223C	1200
75	G.E.	MT-356	900
75	Al-Ch.	ANY-26F	900
75	Al-Ch.	ARY	720
75	G.E.	MT-352	720
75	G.E.	MT-556	720
75	G.E.	IM	600
60	Al-Ch.	ARY	1200
60	G.E.	MT-546	1200
60	*G.E.	MT-536	1200
60	*Westg.	CW-762C	900
50	Westg.	CW	1800
50	G.E.	IM-11A	1800
50	*Al-Ch.	ARY	1200
50	Westg.	CW-636A	1200
50	*G.E.	MT-536	1200
50	Westg.	CW-658-A	900
50	G.E.	MT-336	900
50	G.E.	MT-346	720
50	Al-Ch.	ANY-26F	600
50	G.E.	IM	450
40	G.E.	MT-532	1200
40	*G.E.	MT-336	900

SLIP RING MOTORS

Crane & Hoist Service

3 Phase, 60 Cycle, 220 or 440 Volt

HP	Make	Type	Speed
80	G.E.	MTC-5552	600
75	Westg.	CI-756-A	600
50	Westg.	MW-334	600
50	G.E.	HICTENV	600
35	G.E.	MTC-5536	600
20	Westg.	CI	1200
11	Westg.	CI-E464	900
10	P & H	BW-6	1800
5	P & H	BW-6	1200
5	N. West.	WRC	1200
3	G.E.	MTC-5944	900

SYNCHRONOUS MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2300 volts or higher)

HP	Make	Type	P.F.	Speed
1400	Westg.	HG	.7	900
400	Westg.	HG	1.0	900
300	G.E.	ATI	.8	720
300	*Ideal	SMM	.8	257
275	*G.E. (2)	ATI	1.0	450
250	Al.-Ch.	SYN	1.0	1200
225	G.E.	TS-6244	1.0	300
225	Elec. Mchy.		1.0	360
190	Elec. Mchy.		1.0	720
150	Al-Ch. (2)	SYN	.8	1200
150	Fair.-Mor	TJC-285	.8	720
150	*Elec. Mchy.		.8	1200
150	Westg.	HR	1.0	300
125	*G.E.	TS-7641	1.0	514
125	*G.E.	TS-6214	1.0	277
125	*Elec. Mchy.			900
115	Elec. Mchy.		1.0	240

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2300 volts or higher)

HP	Make	Type	Speed
1250	*Al-Ch. (3)	ANX	3600
1000	*Al-Ch.	ARW	1200
750	*Westg.	CS	900
500	*Al-Ch.	ARW	3500
500	Gen. Elec.	K-6345	1200
500	G.E.	KT-424	450
350	*G.E.	KT-559A	1800
250	West CS-8120S	TEFC	1800
250	G.E. (2)	KT-559	1800
250	*L-Allis	DEX-143	720
250	*G.E.	IK	600
250	G.E.	IK-17A	600
250	Westg.	CS-14	514
200	*G.E.	FT-549Y	3600
200	*G.E.	IK-13B	1800
200	G.E.	IK-16	1200
200	*Al-Ch.	ANZ-TEFC	900
200	*Westg.	CS-930A	900
200	G.E. (2)	KF-564S	720
200	*Al-Ch.	AN	720
200	Westg.	CS-1010	600
200	Al-Ch.	ARWWT	600
150	Cr. Wh.	SC-149 Vent	3450
150	G.E.	IE-13B	1200
150	*Al.Ch.	AN-30F	1200
150	G.E.	IK-15A	900
150	*Westg.	CS	600
125	*Westg.	CS-771 Spgf.	1800
125	*Al-Ch.	AR	1800
125	Westg. (2)	CS-761S	1750
125	Cr-Wh. (2)	Size 5QR	1200
125	G.E.	K-358	900
125	Al-Ch.	AN	514
100	Westg. CS	5075 TEFC	3600
100	*Westg.	CS-760A	1800
100	*G.E.	FT-542Z	1800
100	G.E.	FTRP-543	1800
100	Al-Ch.	ARZ-826FS	1200
100	*Westg.	CS-760D	1200
100	G.E.	KT-553	1200
100	Al-Ch.	AW-23DS6	1200
100	*G.E.	KF-556	900
75	G.E. (2)	FT-529Y	3600
75	Al-Ch. (3)	AR-445S	3600
75	G.E.	KG-445	1800
75	G.E.	KT-537	1800
75	*Al-Ch.	AR505S	1785
75	G.E.	KT-546S	1200
75	*G.E.	KF-542	1200
75	Westg.	CS-664C	1200
75	Al-Ch.	APZ-505	1200
75	G.E.	KT-342	1200

MOTORS DIRECT CURRENT

H.P.	Make	Type	Speed
250	Westg.	SK-220	450/600
200	Rel. (2)	1400T	850/1200
200	Westg.	SK-201	650
200	Cr.-Wh.	CM	500
175	G.E.	ETC	750
100	G.E.	MPC	400/800
100	G.E.	RC-34	2500
100	G.E.	RC-19	575
100/150	G.E.	MCF	380/1000
50	Cr.-Wh.	CMC	700/1100
35	West (2)	SK-150	350/1000
30	Cr.W.	CCM-504	450
30/40	G.E. (2)	CD-123	400/1800
30/40	G.E.	CD-115	500/1500
25/30	G.E. (2)	RF-12	500/1500
25	G.E.	RC-32	800
25	Westg.	SK-133	575
20/25	Westg.	SK-151L	250/1000
20	Star	SB-10	1750
15	Westg.	SK-103	400/1600
10/15	Reliance	185T	400/1600
10/15	Westg.	SK-121	250/1000

MOTOR-GENERATOR SETS

KW	Make	A.C.	D.C.
1250	Westg.	6600/4160	600
1000	G.E.	12000	600
500	G.E.	4160/2300	250
400	A.C.	2300	120/240
300	G.E.	440	250
250	G.E.	440	250
200	G.E.	2300	250/275
200	Westg.	2300/4000	250/275
200	Ridgeway	2300	250
170	G.E.	440	125
150	G.E.	2300	125/250
150	A.C.	2300	275
150	Westg.	2300	125/250
150	G.E.	440	275
125	Cr-Wh. (3)	4160	125
100	G.E.	2300	250
100	Al-Ch.	2300	250
100	Elec.-Mach.	440	125
100	G.E.	440	125
90	G.E.	220/440	125
75	G.E.	440	125
50	Reliance	440	250
50	Ideal	2300	250
50	Westg.	220/440	250
50	Westg.	240	125
50	G.E.	440	125
40	G.E.	440	125
25	Westg.	220	275
20	G.E.	440	250
20	Bogue-G.E.	440	125
20	G.E.	220/440	250
15	Westg.	220/440	250
15	Ideal	440	125

DYNAMOMETERS

HP	Make	Type	Speed
125	G.E. Cr.	TLC-20	2700/6000
150	G.E. 3 Cr.	TLC-50	2500/5000
200	Westg.-Bk.	SK-151	1350/4000

PLATERS

AMP	MAKE	VOLTS
7500/3750	Elec. Prod.	6/12-220/440
7500/3750	Chandy.	12/24-220/440
6000/3000	Chandy.	12/24-220/440
2000/1000	Chandy.	6/12-220/440
1500/750	Chandy.	12/24-220/440
1500/750	Chandy.	6/12-220/440
1000/500	Chandy.	12/24-220/440

TRANSFORMERS

KVA	MAKE	TYPE	VOLT
1000	G.E. (3)	Oil	13200-2300
1000	Wagner (3)	Oil	13800-240/480
833	G.E. (3)	Oil	13800-480
667	Al. Ch. (3)	Oil	34500-2400/4160Y
677	G.E. new (1)	Oil	33000-480
500	G.E. (3)	Oil	11800-480/230
333	Al-Ch. (3)	Oil	13200-2400
250	Westg. (3)	Oil	2400/4160-480/240
150	Chg. El. (3)	Air	2300-110/220
100	Al. Ch. (3)	Oil	2400-240/480
100	Jeff. (3)	Air	2400-220/110
100	Moloney (2)	Oil	2300-220/110
100	G.E. (2)	Oil	2300-115
100	G.E. (1)	Oil	2400-120/240
100	Pitts. (3)	Oil	2400-575
100	Pitts. (1)	Oil	2400-120/240
75	G.E. (3)	Oil	2400-120/208
50	West. (3)	Oil	7200/12470-120/240
50	West. (2)	Oil	2300/1150-115

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CHICAGO *Electric Co.*

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SPECIAL OFFERINGS

TURBO-GENERATORS

1—3000 KW—2400/4160—400# Cond. Ext. 175# & 5#, New 1947

1—2000 KW—2400 volts—400# new 1940. Rebuilt 1947

1—1000 KW—240/480 volts—130/250# Cond. Auto. Extraction—15#—New 1945

1—1000 KW 480 volts—225# Condensing Auto. Extraction—20#

1—1250 KW 480 volts N. Cond. 150#—15# B.P.

1—300 KW — 480 volts — 210# Condensing Auto. Extraction—40#

1—250 KW—240 volts—130#—Non-Cond. 10/12# Back pressure

TRANSFORMERS

1—500 KVA 4160/480 V. Pyranol. 3 ph.

3—1667 KRH—13800/600 volts New 1948

A. LEE ELLIS CO., U.S. Machy. Bldg., 140 Federal St., Boston 10, Mass.

THE BUYERS MUST BE SATISFIED—ALWAYS

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
800	2300	Whse.	900
500	4000/2300	G.E.	600
450	440	Whse.	514
400(2)	2300	G.E.	900
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3600
250	2200/440	G.E.	1200
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2200/440	G.E.	720
150	440/220	Whse.	720
150	2200/440	G.E.	600
125	2200	G.E.	600
100	440/220	G.E.	720

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G.E	ATI	720
375	2200	Whse.	G	900
350	440/220	El. Machy.	Syn.	1200
300	2300/400	G.E.	TS	720
300	2200/440	G.E.	TS	1200
250	440/220	G.E.	ATI	600
150	440/220	G.E	TS	720
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G.E.	FT	3600
500	2200/4000	Elliott	SC	1800
350	2200	G.E.	IM	600
350	440	G.E	KT	1200
300(2)	2200	G.E.	FT	3600
300	2300/4000	L. Allis	FS	1800
250	440/220	G.E.	KT	720
250	2300	Whse.	CS	600
200	440/220	G.E.	KT	1800
200	2200	G.E.	KT	1800
150	2200	Al. Chal.	AR	1800
150	440/220	G.E.	KT	720
150	2200/440		KT	600
150	2200/440	G.E.	FT	1200
125(2)	2200/440	Whse.	X-proof	720
125	2200/440	G.E.	K	600
100(2)	4000/2300	L. Allis	OX	1200

A. C. GENERATORS

1—320 kva, 660 rpm 2300/440/220 V., G.E.
1—360 kva, 900 rpm, 2200 V., Whse.
1—225 kva, 60 rpm, 220/440 V., G.E.
1—187 kva., 1200 rpm, 2200/440 V., Whse.

CIRCUIT BREAKERS

2—1600 amp. ITE, 3 pole, 600 V
6—FKR-155-28, 600 amp., 15,000 V, G.E.
1—400 Amp., Condit, 3P, 25 KV outdoor
1—400 Amp. R. Smith, 3P 7.5 KV outdoor

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	1800
200	230	Cr. Wh.	CMC	1200
150	230	El. Dyn.	B/brg.	600
125	230	G.E.	CD	850

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2200	Syn.	250
150	Whse.	440/220	Sq. Ca.	275
125	G.E	4000/440	Syn.	125
100	G.E.	2200/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	240/120
65	G.E.	2200/440	Sq. Ca.	250
125	G.E.	440	Sq. Ca.	250/125

TRANSFORMERS 60 Cy.

1—1000 kva, Whse., 13,800—2300 V., 3 ph., New
1— 600 kva, Standard, 13,800—2300 V., 3 ph.
3— 500 kva, G.E., 13,800—2300 V.
3— 333 kva, G.E., 13 800—2300 V.
2— 300 kva, G.E., 4150—240 V., 3 ph., Pyr.
3— 200 kva, Mol., 13,800—2300 V.
3— 150 kva, Al. Ch. 2400—220 V.
3— 150 kva, Al. Ch. 440-220 V., dry. New
3— 100 kva, G.E., 2400—240/480, V New
3— 333 kva, G.E., 13,200—480 V.
3— 150 kva, G.E., 13,200—2300 V.
3— 100 kva, G.E., 2400—120/240 V., Pyr.

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NEW STEAM JET AIR EVACTORS

Several in stock, large range in sizes, capacities from 1000 KW to 10,000 KW. Priced right.

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3—500 KVA, 1/60/2300-4000Y to 230/460 Westinghouse OISC, with taps

3—833 KVA, 1/60/34500/460 Moloney OISC, with taps.

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We carry a large stock of rebuilt and guaranteed transformers, and invite your inquiries.

Custom-built transformers and coils manufactured to your specifications.

Expert Repair Service—all makes and sizes of transformers rewound, repaired and redesigned. Ask for our price schedule.

THE ELECTRIC SERVICE CO., INC.
5318 Hetzel St. Cincinnati 27, Ohio
45 Years' Dependable Service

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SKINNER-ENGINE and 250 KW GENERATOR

CURRENT—440—3 P 60 Cy.
WITH CONTROLS

REASON FOR SELLING TO SMALL

WAHLFELD MFG. CO.
PEORIA — ILLINOIS

TURBO-GENERATOR

7500 KW Whse. Cond. 3/60/2400 V.
3600 RPM 400 PSIG 700°
2500 KW Whse. Cond. 3/60/2400 V.
360 RPM 400 PSIG 750°
1500 KW Ell. Cond. 3/60/2400/4150 V
3600 RPM 400 PSIG 750°
1500 KW Elliott, Non-C. 3/60/480 V
3600 RPM 240 PSIG 600° 50# BP
300 KW G.E. Non-C. 3/60/480 V.
3600 RPM 150 PSIG 5#BP

Full line power equipment

BREW, WOLTMAN & CO., INC.
50 Church St., New York 7, N. Y.

COMPLETE POWER PLANT

Turbo-Generator Set complete with Boilers, Condenser, Coal Handling Equipment, etc.

1—7500 KW G.E. Turbo-Generator Set, Condensing Type, 210#, 3/30/2300 volts, 1800 rpm, built approx 1925

4—600 HP B&W Water Tube Boilers, 212# with Stokers

1—Condenser (Worthington, 13,500 sq ft.)

Coal Handling Equipment (including Feeder, Crusher, Bucket Carrier, Belt Conveyor, etc.)

BERNSTEIN BROTHERS
(Since 1890)
100 N. Mechanic St., Pueblo, Colo.

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DIESEL ELECTRIC GENERATOR: General Motors Mod. 8-268A, 1200 RPM, Ser. 10371, direct connected to Westinghouse 200KW, 3 phase, 440V; and 40KW, 120V DC, complete with panel and spare parts $8500.00

CRUSHER, TRAYLOR TY GYRATORY, 2'-4": 5½" feed, Serial 30006, without motor $6500

CRUSHER, TRAYLOR, 12" BULLDOG, with motor $6500

WAH CHANG MINING CORP.
137 Clarke Street, Bishop, Calif.
Phone 8911

A.C. 20 KW DIESEL GEN. SETS

New & Test Run Only

120/208 volt 3-phase 60 cycle 1800 RPM—with voltage regulators on generators and direct connected exciters. DIESEL ENGINE: Sheppard Model 6D—4½x5—3 cyl.—radiator cooled—212.8 cu. inch displacement. Built 1953 and in current production. Spare parts available.

THE BOSTON METALS CO.
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Baltimore 2, Md.—Lexington 9-1900

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5—OIL CIRCUIT BREAKERS

Whse. late type, outdoor type, De-Ion Grid, T.P.S.T., Rated 161000 V., 1200 amps., 60 cy., 3 ph., Type GO-3, Interr. Duty 1,500,000 KVA.

Fully complete—Cond. like new.

Price and further inf. upon request.

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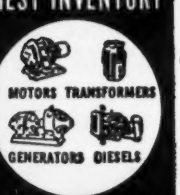
WORLD'S LARGEST INVENTORY

NEW AND GUARANTEED REBUILT EQUIPMENT



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GOOD USED

TRANSFORMERS

SINGLE PHASE — 60 CYCLE

3 KVA to 75 KVA

2400/4160Y-120/240 Volt

1½ KVA to 50 KVA

2400—120/240 Volt

3 KVA to 37½ KVA

720/12470Y—120/240 Volt

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1—202 H.P. 150 Lb. Keeler Scotch—1943
1—165 H.P. 15 Lb. Titusville Scotch

PACKAGE UNITS

1—200 H.P. 250 Lb. Walsh-Widner Semi package
1—200 H.P. 15 Lb. Cyclotherm #6—Oil
4—90 H.P. 125 Lb. Cyclotherm #2—Oil
1—80 H.P. 125 Lb. Cyclotherm #6—Oil
1—80 H.P. 250 Lb. Cyclotherm #5—Oil
1—50 H.P. 125 Lb. Cleaver-Brooks #2—Oil
2—50 H.P. 125 Lb. Cleaver-Brooks #20—Oil & Gas
1—20 H.P. 153 Lb. Powermaster #2—Oil
1—10 H.P. 150 Lb. Cyclotherm #2—Oil
1—10 H.P. 100 Lb. Ames—Gas

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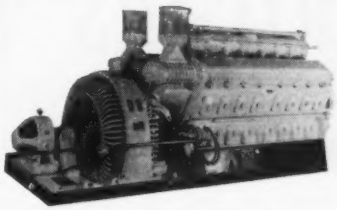
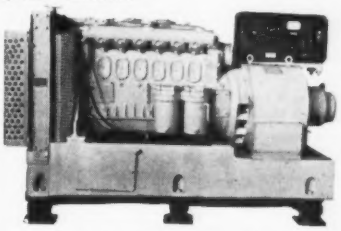
OUTSTANDING VALUES!

DIESEL DRIVEN GENERATORS — PRICED TO SELL



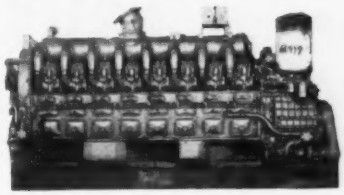
G.M. 16-567—1250 KVA—A.C.

1250 KVA 4600/2300 volt 3 phase 60 cycle 720 RPM Westinghouse sync. A.C. generator—80% P.F.—S.O. 6P455 with direct connected 10 KW exciter. Spare parts include (1) factory reconditioned blower; (1) extra blower; and a quantity of new pistons, liners, heads, bearings, etc. Unit complete with Westinghouse oil circuit breaker —15000 volts—type F-124—600 amps—60 cycle —solenoid operated—mounted in drawer-type cubicle 20" wide—44¼" deep—88" high. Motor operated rheostats.



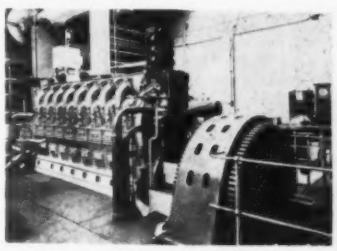
G.M. 6-71—60 K.W.—A.C.

GM 6-71 radiator cooled self-contained diesel generator sets—60 KW 440 or 220 volts 60 cycle 3 phase 1200 RPM with direct connected exciters and self-contained panel boards, including rheostats, SilverStat voltage regulator, ammeters, voltmeters. These units are guaranteed to be in perfect running condition and can be demonstrated at our plant. The generators were made by Delco and are ball-bearing drip-proof marine type. Engines are famous GM 6-71 6-cylinder 2-cycle 4¼ x 5—equipped for electric starting. Equipped with radiator, self-contained fuel tank, all controls, etc. Mounted on pre-fab sub-base. 8 available.



G.M. 16-278A—1200 KW—D.C.

(1) 16-278A diesel generator set. GENERATOR: 1200 KW—525 volts DC—3000 amps—720 R.P.M. —shunt wound. (Generator not shown) ENGINE: #11977—complete with full flow filters; Harrison heat exchangers; strainers; pyrometers, etc. 1600 HP at 720 RPM—formerly in Navy DE. Never in commercial use. Generator is totally enclosed air-cooled drip-proof marine type mfg. by Allis-Chalmers. Excellent for dredges and other DC requirements.



1250 KVA DIESEL A.C. POWER PLANT

Modern 1250 KVA 1000 KW 420 volt 3 phase 50 cycle 4-wire diesel driven alternator set, mounted on a fabricated baseplate and direct coupled at 750 RPM, incorporating: ENGINE—G.M. 16-278A —#11691, dated 1943; 1700 b.h.p. 16-cylinder 2-stroke cycle; cold starting; cylinders 8¾" x 10½"; complete with hydraulic governor and overspeed trip. Direct coupled to: ALTERNATOR —by Electric Machinery Co—#97688. Revolving field, 0.8 P.F.; 1720 amp. per phase; 750 RPM; single pedestal oil ring lubricated bearing; direct coupled exciter 12.5 volts 52 amps. Engine has standard fittings and ancillaries.

The BOSTON METALS Co.

313 East Baltimore Street, Baltimore 2, Maryland
CURTIS 7-5050 LEXINGTON 9-1900

3 NEW BOILERS

Available at fraction of new cost

BABCOCK & WILCOX single uptake controlled superheat marine type express boilers, 3 drums, with economizers.

Designed pressure	634 lbs.	Steam temperature	850°F
Operating pressure	550 lbs.	Furnace volume	1473 cu. ft.
Superheated steam	221,000 lbs./hr.	Total generating surface	9338 sq. ft.
Saturated steam	32,000 lbs./hr.	Superheater surface	1620 sq. ft.
Full power total	253,000 lbs./hr.	Economizer surface	3843 sq. ft.

NOTE: These boilers are new and complete. They are erected and ready for use and should therefore be considered only for such places as can be reached by water transportation.

HUGO NEU CORPORATION
45 Nassau St. Tel.: REctor 2-1334 New York 5, N. Y.

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B.F.Goodrich report:

Rubber turns a mountain inside out

B. F. Goodrich improvements in rubber brought extra savings

Problem: This is part of a 7-mile-long tunnel that will carry billions of gallons of water to a power plant. In digging the tunnel, they've practically turned a mountain inside out.

As fast as dirt and rocks (some of them boulders weighing 3000 pounds each) are blasted out, they're dumped on a rubber belt and carried away. But the smashing blows of 1½ ton rocks were pounding conveyor belts to death. Some split in two; others had their covers ripped off.

What was done: B.F.Goodrich engineers were asked to develop a belt that could stand the abuse. They started with the B.F.Goodrich cord belt, so called because it has cords running lengthwise, buried in rubber. To this they added several layers of Nyfil fabric, which gives extra strength to the belt without making it heavy and bulky. Special rubber compounds were used for the cover to stand the cutting and gouging of the rock.

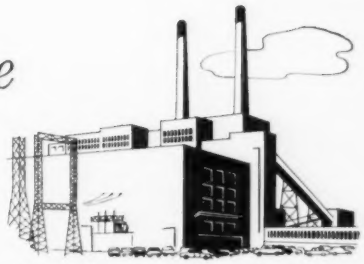
Savings: The B.F.Goodrich belt was put to work here. It stood the banging, crashing better than any belt previously used. It lasted longer, carried more tons. B.F.Goodrich belts have now carried two-thirds of all the rock hauled out of here.

Where to buy: Your B.F.Goodrich distributor has full information on the conveyor belt described here. And, as a factory-trained specialist in rubber products, he *can* answer your questions about *all* the rubber products B.F.Goodrich makes for industry. *B.F.Goodrich Industrial Products Co., Dept. M-962, Akron 18, Ohio.*

B.F.Goodrich

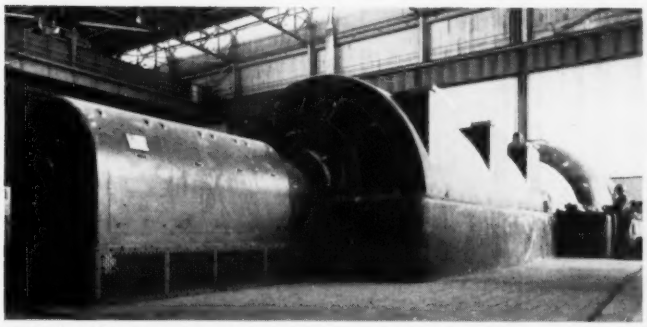
INDUSTRIAL PRODUCTS

Grinnell provides *complete fire protection* for vital areas at Detroit Edison Company

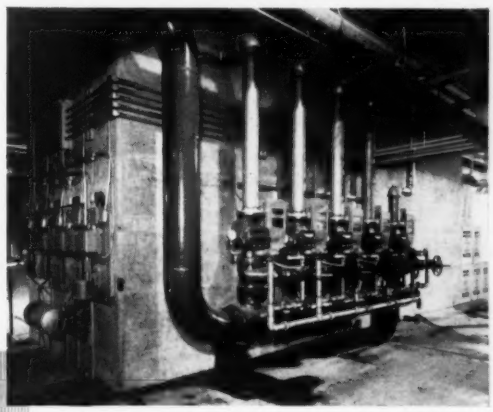


Pictures below taken at River Rouge Power Plant of Detroit Edison Company.

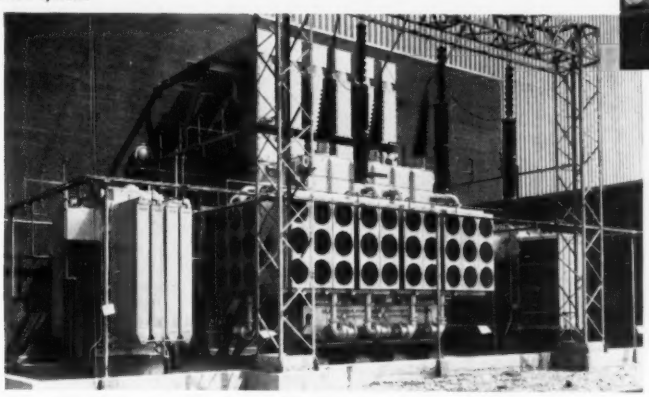
GRINNELL MULSIFYRE SYSTEM FOR EXTINGUISHING OIL FIRES



Grinnell Mulsifyre System provides efficient protection for hazardous areas of turbine lubrication system.



Automatic control valves for various fire protection systems throughout station.

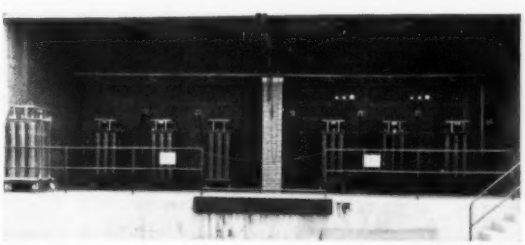


Around-the-clock protection for world's largest capacity (315,000 kva) generator transformer provided by Grinnell Mulsifyre System.

Complete extinguishment of fires within areas protected by Grinnell Mulsifyre is usually obtained in a matter of seconds after water discharge starts. Case histories prove that Mulsifyre projectors are effective wherever the danger of fire in medium or heavy oils can be limited to a definite area. In these oils the surface emulsion remains to give after-protection against flashback. Detailed information on Grinnell Mulsifyre will be sent on request.

GRINNELL PROTECTOSPRAY FOR COOLING AGAINST FIRE EXPOSURE

Flammable gases having wide explosive limits require protection against input heat when stored under pressure to prevent bursting of the containers. Hydrogen gas, with explosive limts of 4 to 75 percent when mixed with air, requires protective cooling whenever and wherever its container faces the danger of exposure to possible fire or heat from fire.



Grinnell ProtectoSpray System stands guard at hydrogen cylinder storage dock.

GRINNELL WHENEVER FIRE PROTECTION IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Branch offices in Principal Cities

PERMUTIT® presents the

VALVELESS FILTER

Completely Automatic Gravity Filter Costs Less than Manual Unit

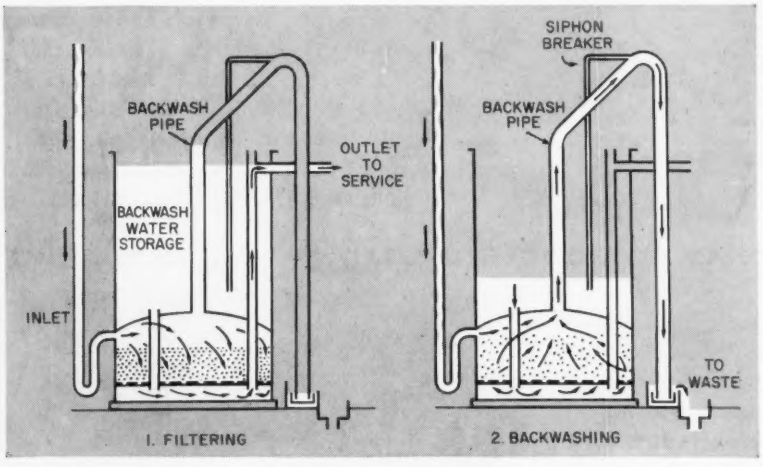
Uses no valves, no pumps, no flow controllers

Here's an entirely new concept in water filters for cities, factories and power stations: a filter that *eliminates* operation and maintenance expense . . . yet costs *less* than a conventional manually-operated gravity filter of the same size.

The Permutit Valveless Filter can be used wherever gravity flow is feasible. Units are now in operation providing both plant process and drinking water.

FOOLPROOF OPERATION

The Valveless Filter thinks for itself. It starts backwashing at a predetermined head loss, rinses and returns to service automatically . . . and as efficiently as an expertly operated manual filter. It assures uniform, high quality effluent because it eliminates "human error." It cannot be forced. It cannot backwash or rinse too soon or too late, too fast or too slow, too much or too little. It cannot develop a negative head and thus eliminates the chief cause of mudballs, channelling, upset beds. The absence of gravel eliminates another cause of upset beds. Backwash or rinse water cannot be accidentally run to service.



HOW IT WORKS

Filtering. Water enters at left, flows through sand, strainers and false bottom up effluent duct to service. As head loss increases during run, water rises in backwash pipe. At maximum headloss, water spills into downward section of backwash pipe and starts backwash (siphon) action.

Backwashing. Siphon draws water from storage down through ducts, up through strainers and sand to expand and wash bed, then to waste. At low storage level, air enters siphon breaker to stop backwash. Flow reverses and filtered (rinse) water flows into storage until full. All flow then goes to service.

PROVEN PERFORMANCE

Photo shows two Valveless Filters in a large industrial plant. (Shut-off valve at left is used only to take front filter out of service.)

LOW INSTALLATION AND EXPANSION COST

Filters up to 10 ft. diameter are shipped set up. Piping is simple. Future filters are easy to add since they require no additional backwash water storage or pump capacity. Filters use minimum floor space.

FREE BULLETIN

New bulletin, "The Permutit Valveless Filter," includes details, drawings, operating conditions, capacities. Address: The Permutit Company, Dept. P-6, 330 West 42nd St., New York 36, N. Y. or Permutit Company of Canada Ltd., Toronto 1, Ont.

PERMUTIT®

rhymes with "compute it"

Water Conditioning

Ion Exchange • Industrial Waste Treatment